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Waste Minimization Issues and Options
Volume 3: Appendices C through K

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RECYCLING TECHNOLOGIES AND PRACTICES

RECYCLING TECHNOLOGIES AND PRACTICES

C.1 Solvent Recycling Technologies

Solvent wastes are recycled by various unit treatment operations, which may be performed singly or in sequence. These operations are grouped into the following technology categories: distillation; solids removal; liquid-liquid phase separation; emulsion/dispersion breaking; dissolved and emulsified organics recovery; and organics vapor recovery. The recyclable product of the operation may be the solvent or the isolated contaminants, or both. Applications and limitations of use of solvent recycling operations are presented in Table C-1 and discussed below.

Distillation

Separation techniques that rely on the boiling point differences of the components of a liquid waste are called distillations and include pot distillation, steam distillation, fractional distillation, film evaporation, and drying techniques. Purification of organic solvents for recycling in process applications usually requires at least one distillation step to remove wastes of low volatility. Distillation is the dominant recycling technology for solvent wastes.

- Pot Distillation describes the process of heating liquid indirectly to boiling in a pot and then recovering by condensation of the vapors that are in equilibrium with the remaining liquid. Nonvolatile residues removed from the pot also are reclaimed (e.g., by dryers) for use as fuel or for disposal. Pot distillation can be performed in a batch or continuous mode of operation under vacuum or atmospheric pressure. Operation under vacuum enhances removal of organics from heavy residues.

  Pot distillation is effectively used to reclaim halogenated as well as nonhalogenated solvents from wastes. For example, acetone used as a paint cleaner is commonly recovered from nonvolatile oils, resins, pigment, etc., by pot distillation. The technology is widely used by (offsite) commercial solvent recovery operations.

Table C-1 Summary of Recycling Technologies for Solvent Waste Streams

Type of process	Description of technology	Applications	Limitations of use
Distillation			
Flash distillation	Distillation in which an appreciable proportion of a liquid is quickly converted to vapor in such a way that the final vapor is in equilibrium with the final liquid (Condensed Chemical Dictionary 1985). Nonvolatile residues are removed for fuel reuse or disposal.	Allows for solvent recovery. (Also used for desalination of sea water.) Widely used.	Solvent must not be thermally unstable.
Fractional distillation	Distillation in which the product is collected in a series of separate components of similar boiling range. Part of the vapor is condensed, and the resulting liquid is contacted with more vapor, usually in a column with plates or packing (Condensed Chemical Dictionary 1985).	Allows for recovery of reasonably pure solvent. Widely used.	Not applicable to azeotropic mixtures.
Film evaporation	A set of rotating blades inside a cylinder moves the waste material so that the material is evaporated.	Same as above, except less frequently used.	Same as above. Capital costs are higher than for other distillation methods.
Steam distillation	Heating accomplished by steam injected directly into the solvent.	Distillation at lower temperatures.	Problems with product stability, corrosion, foaming, and condensate water disposal.
Dryers	Dryers achieve removal by distillation of remaining solvents from heavy viscous organic wastes. Solvent vaporized off of two horizontal cylindrical drums heated internally. Solvent vapors are condensed and recovered; solids scraped off drum and packaged for disposal.	Allows for dry product recovery; frequently used.	Requires condensation equipment to recover solvents.

Table C-1 (continued)

Type of process	Description of technology	Applications	Limitations of use
Solids removal			
Sedimentation	The settling out by gravity of solid particles suspended in a liquid (Condensed Chemical Dictionary 1985). Oversize and heavy solids drop out readily on standing.	Preliminary purification step; allows for discharge of water contained in waste, and for recovery of recyclable materials. This is a widely used technology.	Finely divided solids or emulsified materials sometimes difficult to remove by sedimentation or filtration.
Filtration	Separation of suspended solids from a liquid (or gas) by forcing the mixture through a porous barrier (Condensed Chemical Dictionary 1985). Solids larger than the pore openings in the filter media are removed.	Same as above.	Because of the array of filtration equipment, costs vary widely.
Centrifugation	A separation technique based on the application of centrifugal force to a mixture or suspension of materials of closely similar densitites (Condensed Chemical Dictionary 1985). The settling force created by the centrifuge enhances separation of small particles and less dense solids.	Same as above, except the technology is less frequently used.	Power requirements are high, and operating supervision and maintenance costs may be high.
Liquid-liquid phase separation			
Decant tank	Liquid phases will separate in storage so that one phase can be pulled off the top and one off the bottom.	Allows for recovery of spent solvents for reprocessing. This is a widely used, inexpensive technology.	Separated nonaqueous liquid will be saturated with water and may require further treatment before reuse.
API separator	Rate of separation of liquid phases is increased in an open basin with large surface area.	Allows for recovery of oily or petroleum-based materials. This is widely used in the petroleum industry.	Same as above; also, recovered materials may contain some tar-like substances.

Table C-1 (continued)

Type of process	Description of technology	Applications	Limitations of use
Liquid-liquid phase separation (continued)			
Tilted plate separator	The addition of tilted plates to an open basin further increases the rate of separation in proportion to the projected horizontal surface area.	Same as above. This technology is less frequently used than the above two processes.	Separated nonaqueous liquid will require further processing before reuse.
Emulsion/dispersion breaking			
Coalescence	The union of droplets of a liquid to form a larger droplet, brought about when the droplets approach one another closely enough to overcome their individual surface tensions (Condensed Chemical Dictionary 1985). Liquids are pumped through a fine mesh to which entrained droplets tend to cling; an oleophilic medium can be used to enhance attraction of entrained droplets.	Preliminary separation of aqueous-phase waste to be treated by biological methods before reuse. This method is infrequently used.	Some emulsions are difficult to handle, particularly those containing surfactants.
Centrifugation completely	Used to remove small amounts of water as well as solids from recovered fuel.	Same as above; also used for recovery of nonaqueous material.	Fine dispersants may not be separated by this method.
Chemical de-emulsifying agents	Addition of chemical agents to raise or lower pH or to change attractive forces between particles causes some solvents and oils to separate out of water into a liquid organic phase.	Same as above; however, it is used only with emulsions.	Some emulsions may require large amounts of chemicals. Chemical emulsifying agents are more expensive than the air flotation process.

Table C-1 (continued)

Type of process	Description of technology	Applications	Limitations of use
Emulsion/dispersion breaking			
Air flotation	Fine organic droplets and/or particles are removed from water by introducing air bubbles which attach themselves to the droplets and are then carried to the surface and skimmed.	Same as for centrifugation.	Recovered organics require considerable processing before they can be reused.
Dissolved and emulsified organics recovery			
Steam or air stripping	Waste is pumped to top of a packed column. Steam or air is fed through the column from the bottom, picking up volatile organics. Organics are recovered from the condensate.	Discharge of treated wastewater; recovery of stripped materials is also possible. This is widely used to remove ammonia from water.	May cause air emissions problems if stripped materials are vented to atmosphere. Limited to use with volatile materials.
Carbon absorption	Water with dissolved organics is pumped through bed of activated carbons which absorb the organics. Bed regenerated with steam or certain solvents to recover organics.	Removes large variety of organics from wastewater. This is more costly than steam stripping. It is widely used to remove trace organics from wastewater.	High cost of regenerating the carbon or incinerating it. Requires trained operators and close monitoring for efficient operation. Not effective on ethylene (Condensed Chemical Dictionary 1985).
Solvent extraction	Water and organic contaminants percolated through a packed column; preselected solvent, pumped in counter-current, dissolves the contaminant. Spent solvent is redistilled leaving organic waste residue.	Allows for recovery of dissolved organics from an aqueous solution. Less frequently used than above two methods.	Solvent losses to water Need for further processing to recover materials.

Table C-1 (continued)

Type of process	Description of technology	Applications	Limitations of use
Dissolved and emulfisied organics recovery (continued)			
Supercritical fluid extraction	Similar to above, except solvent is at a temperature above its critical point so acts as a fluid. CO_2 is being tested on this application; selectively extracts organic solvents from wastewater.	No commercial applications were identified during this study.	Substantial energy savings over distillation processes, but high-pressure operating equipment is higher in cost than conventional processing equipment. Requires trained operators; must be well designed to prevent explosions.
Membrane separation	Highly efficient filtration system. Membrane pore openings are submicron size (0.0025-0.010 u). Molecules of water and low molecular weight compounds pass readily; larger organic molecules and colloidal particles build up in the recirculation stream until it can be used as fuel.	Recovery of some dissolved organics. Membranes of cellophane, collodion, asbestos fiber, etc., are used in waste liquor recovery, desalination, and electrolysis.	Membrane technology is higher in cost than older technology. Fairly costly compared to other processes.
Organic vapor recovery			
Condensation	Solvent vapors recovered by being fed through a condenser cooler.	Recovery of solvent and reduction of evaporative losses.	For some materials, condensers may require refrigeration, which is expensive.

Table C-1 (continued)

Type of process	Description of technology	Applications	Limitations of use
Organic vapor recovery (continued)			
Carbon adsorption	Beds of activated carbon are used to selectively adsorb organic vapors from gas streams. Spent carbon regenerated with steam; steam and concentrated organics are recondensed and separated.	Removal of organics from air emissions.	Carbon regeneration or incineration is costly. Process requires close control and well-trained operators.
Absorption	Gas and liquid streams flow countercurrent to each other; gaseous material is transferred to the liquid streams.	Recovery of gaseous organics not easily confined, such as paint overspray. Limited use.	Most organics do not have high solubility in water. Most applicable to high-temperature gas streams.

- Steam Distillation is similar to pot distillation except that heat is supplied by direct steam injection which reduces the distillation temperature. Steam distillation is applicable to the recovery of solvents that are water insoluble (i.e., all water-insoluble nonhalogenated solvents and water-insoluble halogenated solvents). However, product instability, corrosion, foaming, and condensate water disposal may cause problems with this process.

  One restriction on the use of steam distillation is that the recovered solvent must have a significant vapor pressure at or below the boiling point with water. A second restriction is that the substance to be recovered must be stable under distillation conditions. Despite these two limitations, steam distillation has been used to recover semi-volatile organics from a variety of process waste streams in the organic chemicals industry.

- Fractional Distillation is generally used to separate individual components of waste solvent mixtures in cases where the boiling points of individual constituents are fairly close to one another. In this process, the feed stream enters a distillation column which contains plates on packing which provide a high surface area of vapor-liquid contact. Vapors from the top of the column are collected and condensed, and a portion of these is returned to the column.

  Boiling point differences among the various constituents strongly affect the design (i.e., number of stages) of a fractional distillation column. The closer the boiling points of the compounds being separated, the greater the number of stages required to achieve efficient separation.

  Individual applications of fractional distillation to recovery of solvents from waste streams include: recovery of acetone from wastewater generated from printed circuit board cleaning operations; onsite recovery of isopropanol from wastewaters generated by the organic chemical industry; and recovery of solvents from aqueous and nonaqueous mixtures in the specialty organics industry (Versar 1980). A case in point is the separation and recovery of acetic acid and benzene separately from ternary mixtures of these compounds with water.

- Azeotropes. Solvents forming azeotropes can also be recovered by fractional distillation with some modifications (an azeotrope is a liquid mixture with a constant boiling point; azeotropes exhibit a minimum or maximum boiling point relative to the boiling points of surrounding mixture compositions). The most common method to break a binary azetrope is to add a third component (also called entrainer), which forms a ternary azeotrope. The ternary azeotrope separates in two layers, one of which is enriched in one of the feed components. This layer is decanted while the other layer, containing most of the entrainer, is reintroduced into the distillation column (i.e., refluxed). For example, water can be removed from a 95 percent ethanol/5 percent water mixture using azeotropic distillation with benzene.

Another method of breaking azeotropes is by changing the pressure of distillation. The methyl ethyl ketone-water azeotrope, which contains 35 percent water at atmospheric pressure and 50 percent water at 100 psi pressure, can be broken by distilling the mixture first at atmospheric pressure and then at a higher pressure.

Viscous wastes, including solvents/resin mixtures, can be recovered using film evaporation. Wiped- and scraped-film evaporators have a set of rotating blades housed in a steam-jacketed cylinder. As the waste is heated, the blades move the material so that heat transfer at the jacket surface is maintained. The bottom residue must flow to remove it from the equipment. This technology generally is more expensive to install than other distillation techniques and is not widely used.

- Dryers handle distillation residues and separate solvents from heavy viscous organic wastes. The drum consists of two horizontal, internally heated cylindrical drums that rotate in contact with each other. Viscous solvent waste is fed into the annulus between the drums; the solvent is vaporized, and the resins and other nonvolatiles are pressed into a flat sheet as they pass down between the drums. The solvent vapors are condensed and recovered, while the solids are scraped off the drum and packaged for disposal. Drying technologies have potential application to semi-solid, viscous, nonpumpable, or barely pumpable sludges that currently are landfilled.

Solids Removal (Liquid-Solid Phase Separation)

Elimination of suspended solids is a necessary pretreatment for certain recycling technologies (e.g., fractional distillation) to reduce fouling. Removal of fine stabilizing solids, which cause oil/water emulsions, enhances the subsequent separation of liquid phases. Techniques for the removal of suspended solids from liquid solvents include sedimentation, filtration, and centrifugation. Filtration or centrifugation are required for removal of fine particles.

- Sedimentation is accomplished in tanks or holding ponds where heavy solids fall out of the suspension by gravity.
- Filtration includes any method by which solids larger than the pore openings of a filter medium are retained by the filter. Specifications and costs of filter equipment vary widely.
- Centrifugation is commonly used to dewater sludges and to remove oil and dirt from metal parts. The settling force created by a centrifuge enhances separation of small and low specific gravity solids. Requirements for energy, maintenance, and operating supervision may be high.

Liquid-Liquid Phase Separation

Water-insoluble solvents can be separated from wastewater in one or more organic liquid phases, and then reclaimed or reused. For example, nitrobenzene and aniline are separated from the wastewater resulting from aniline production. The aniline is recycled to the process.

Types of equipment available for liquid-liquid phase separation include decant tanks, API separators, and tilted-plate separators. API separators enhance the rate of separation achievable in a decant tank by using an open basin with a large surface area. The addition of tilted plates to an open basin further increases the rate of separation in proportion to the horizontal surface area.

Emulsion/Dispersion Breaking

Dispersions of solvent or oil droplets in water or of water droplets in oil can be separated by the use of a coalescer, centrifuge, or air flotation equipment, or by the addition of chemical de-emulsifying agents.

- Coalescence. When emulsions are pumped through a fine mesh, oil droplets will coalesce into large drops that separate readily. Attraction of the oil droplets can be enhanced by the use of an oleophilic medium.

- Centrifugation can be used to remove small amounts of water (as well as solids) from recovered fuel. This technology has been applied to the shipboard removal of oil from ballast water and, by the electric utilities industry, to separate impurities from spent dielectric fluids processed for reuse.

- Air Flotation. Oil droplets (or particles) also may be removed from water by dissolved or diffused air flotation. Air for the process first is dissolved under pressure in a recycle stream, which then is released directly or through a fine diffuser into an air flotation tank. The air bubbles become attached to the droplets or particles, float to the surface, and are skimmed. Chemical agents often are added to improve flocculation. In petroleum refineries, dissolved air flotation is commonly used to remove oil from oil-in-water emulsions. Recovered oil is recycled to the refinery process (Jacobs Engineering 1975).

- Chemical De-emulsifying Agents added to liquid wastes raise or lower the pH of the liquid or change the attractive forces between the particles. These processes separate solvents and oil from the water phase into a liquid organic phase.

Dissolved and Emulsified Organics Recovery

Organics separation techniques such as steam or air stripping, carbon adsorption, and solvent extraction are generally considered wastewater treatment methods. The organics that are removed are concentrated and amenable to recovery.

- Steam Stripping. In steam stripping, steam (or air) fed to the bottom of a packed column picks up volatile organics from wastes pumped onto the top of the column. The organic vapors recovered at the top of the column are condensed, and the organics are recovered from the condensate. This process is used commonly to remove chlorinated solvents (e.g., methylene chloride) from wastewater.

- Carbon Adsorption. Wastewaters with dissolved organic solvents in low concentrations (less than 1 percent) can be pumped through a packed bed of activated carbon, which preferentially absorbs the solvent. When the carbon becomes loaded with the solvent, the bed can be regenerated with steam or another solvent. Although carbon adsorption has been used successfully to remove low concentrations of halogenated solvents (such as chloroethane, chloroform, 1,1-dichloroethane, 1,2-dichloroethane, 1,2-dichloropropane, 1,1,1-trichloroethane, 1,1,2-trichloroethane, and phenol) from organic chemical industry wastewaters, the solvents evolved as gases during the regeneration of the carbon are not recovered for reuse. Instead, the evolved gases are incinerated (USEPA - Effluent Guidelines Development Document Organic Chemicals 1981).

- Solvent Extraction. Separation of liquid waste constituents is achieved more commonly by solvent extraction. The wastewater is mixed with a solvent that extracts certain components of the waste stream, but is immiscible with the remainder of the waste. Then the solvent is recovered and recycled to the process, leaving the residual organic waste.

  The principal use of solvent extraction technology is in the organic chemical industry (USEPA - Effluent Guidelines Development Document - Organic Chemicals 1981). Phenol from wastewater is commercially recovered by extraction with isopropyl ether followed by distillation. The recovered phenol is recycled to the process or sold as a chemical. Solvent extraction (with water as the solvent) is used to recover water-soluble organics from halogenated hydrocarbon solvents.

- Supercritical Fluid Extraction is similar to solvent extraction, but uses an extracting solvent whose temperature has been raised above its critical point (where it no longer exists as a solid, liquid, or gas, but simply as a fluid). Critical Fluid Systems Inc, is testing supercritical carbon dioxide (CO_2), which exhibits unique solvent properties in this range. Super critical

CO_2 selectively extracts organic solvents (e.g., isopropanol) from wastewater. Then the CO_2/solvent mixture is decompressed, allowing the CO_2 to vaporize, and leaving the extracted organic solvent residue. Finally, the vaporized CO_2 is recompressed above its critical point and recycled to the process. No commercial applications of supercritical fluid extraction to recovery of hazardous masks were identified during this study.

- Membrane Separation is accomplished by applying external pressure to one side of a membrane so that solvent in a liquid wastestream will flow in the opposite direction. Molecules of water and low molecular weight compounds readily pass through the membrane, while the larger organic molecules build up in the recirculation stream, becoming concentrated.

  Either ultrafiltration or reverse osmosis can be used to achieve membrane separation. Ultrafiltration units have membrane openings ranging from 0.0025 to 0.010 micron and operate at about 50 psig. Reverse osmosis units have smaller membrane openings (0.0005 to 0.0025 micron) than the ultrafiltration units, but operate at much higher pressures (several hundred pounds). Ultrafiltration is applied in both onsite and offsite recovery operations to concentrate waste organics.

Recovery of Organic Vapor from Gaseous Waste Streams

Solvent vapors are recovered from gaseous waste streams by condensation, carbon adsorption, or absorption into a liquid stream.

- Condensation can be used alone (e.g., to recover volatile solvents from storage tanks) or in conjunction with such unit operations as distillation, carbon adsorption, and air or stream stripping. Solvent vapors are recovered through a condenser cooled by recirculated cooling water, chilled water, or a refrigerant. The choice of coolant is one of economics and performance (i.e., adequate volatile organic chemical removal).

- Carbon Adsorption, described previously for liquid-liquid phase separation, has been used to recover low concentrations of solvent (e.g., acetone) vapors from gas streams. General application of carbon adsorption technology to recovery of solvents for reuse has been limited for safety reasons. Activated carbon can catalyze the decomposition of some organics, resulting in hot spots and possible bed fires. (However, the technology is widely used in the organic chemical industry to limit airborne emissions of toxic vapors.)

- Liquid Phase Absorption is the transfer of a solvent from the gaseous stream into a liquid stream. Continuous contact of gas and liquid is required. The absorption apparatus may be a tower filled with solid packing material, an empty tower into which the liquid is sprayed and through which the gas flows, or a tower containing a number of plates for increased surface area. The gas and liquid streams are maintained in countercurrent flow, thereby achieving maximum concentration driving force and the highest possible rate of absorption of gas by the liquid phase. A new absorption process recovers volatile organic chemical emissions from paint spray booths using an oil-in-water emulsion. After absorption, the emulsion is separated into clean water and a solvent-oil rich phase. The water is recycled to the paint booth, and the solvent-oil rich phase is processed to recover the solvent and recycle oil to the absorption loop.

C.2 Halogenated Organics (Nonsolvent) Recycling Technologies

Halogenated organic wastes that are not solvents include the chlorinated hydrocarbon pesticides and intermediates (e.g., chlorinated phenols, halogenated aliphatic pesticides, aldrin, and toxaphene); polychlorinated biphenyls (PCBs); and other chlorinated organic wastes such as epoxy strippers and still bottom residues from recovery of halogenated solvents.

Recycling opportunities are generally more restricted for this class of material for two reasons: (1) some of these wastes, particulary those containing polyhalogenated aromatics, may be contamined with dioxins, and (2) markets for some possible products, such as carbon tetrachloride, have been declining sharply in recent years.

Technologies available for recycling nonsolvent halogenated wastes, either for reuse or heat recovery, are discussed below. The uses and limitations of each technology are summarized in Table C-2.

Pesticide Dusts

Halogenated organic pesticides and pesticide intermediates usually are recycled onsite. Dusts and particulates generated either from product drying during pesticide manufacture or from blending operations during pesticide formulation are collected by baghouse filters and recycled to the process.

Pesticide Wastewater

Recycling of wastewater from pesticide production also is practiced commonly in conjunction with solvent extraction, steam stripping, and distillation operations (see Table 4-2).

Table C-2 Summary of Recycling Technologies for Halogenated Organics Waste Streams

Type of process	Description of technology	Applications	Limitations of Use
Fuel use	Halogenated organic wastes are used as fuel in cement kilns. Energy is recovered as well as acid gas, which reacts with free alkali in the cement to produce a low-alkali cement.	Recovers heat during thermal destruction of organics. Method is widely used.	Limitation imposed by maximum halogen loading per ton of cement. At high halogen loadings, salts formed by reaction of acid gases and alkali in the cement will begin to fuse into a molten ring. Interferes with operation of the kiln.
Solvent extraction	Dimethylformamide (DMF) solvent extracts PCBs from waste oils; water washing in second stage to separate out solvent and leave a PCB concentrate.	Process yields a decontaminated oil, which could be further processed to give a recyclable product.	Extraction efficiency depends on relative solubilities of PCB in DMF and other media; in some cases, may not give a completely decontaminated fluid.

Exhaustive Chlorination

A commercial process that involves high temperature (600° C) and exhaustive chlorination converts chlorinated hydrocarbon wastes to a salable product, carbon tetrachloride. This process has been used by Dow Chemical Corporation at their Freeport, Texas, facility (Versar 1975). However, portions of the process at Freeport have been discontinued (Chemical Week 1985). Exhaustive chlorination can be used to convert highly chlorinated still bottoms generated from distillation of crude halogenated solvents to carbon tetrachloride. Such reclamation operations also have practiced by Ethyl Corporation and Vulcan Materials (Versar Inc., 1975; Versar Inc., 1980; personal communication with Mr. John Huguet, Ethyl Corporation, February 1980).

Reclamation of PCB-Contaminated Waste Oil

Polychlorinated biphenyls can be removed from waste oil by extraction or the waste oil can be dechlorinated. Both processes are available commercially for offsite or onsite applications.

- Dechlorination. State-of-the-art dechlorination processes reclaim waste oils contaminated with PCBs at concentrations between 50 and 10,000 ppm so that the oil can be reused. These processes use sodium compounds to dechlorinate the PCB molecules and produce a nonhalogenated organic compound and a sodium salt. The new processes are patented by PPM, Acurex, and Sunohio, and are improvements over the original dechlorination process investigated by Goodyear Tire and Rubber Company. Dechlorination process equipment is mounted on mobile equipment, which can be brought to the site of the generator's facility (usually a transformer requiring service).

- Solvent Extraction. Another new process, based on solvent extraction, is suitable for removing PCBs from waste oil. This process, dimethylformamide (DMF) extraction, also reduces the volume of PCB waste by a factor of 10. The steps of the process are: extraction of PCBs with DMF; extraction with water of the DMF from the DMF-PCB mixture; and recovery and purification of the DMF by distillation. The purified DMF is recycled to the process, and the decontaminated oil can be reused. The concentrated PCB-containing residue requires disposal as a hazardous waste.

Heat Recovery from Halogenated Organic Wastes

Halogenated organic wastes can be incinerated for heat recovery during the manufacture of other chlorinated organics or in cement kilns. A new process catalytically destroys the chlorinated hydrocarbon byproducts of vinyl chloride monomer production and recovers heat and chlorine value without environmental pollution (Benson 1979). In cement kilns, the temperature and extended residence time required for adequate calcination of cement ensure efficient destruction of halogenated organic wastes. In addition to recovering energy value from the waste during its destruction, the acid gas generated reacts with free alkali in the cement to produce a low-alkali cement. This product is desirable in a number of market applications.

The primary limitation to the use of halogenated organic waste in cement kilns is the maximum halogen loading per ton of cement. Cement kilns typically limit chlorine content of the waste fuel to a maximum range of 5 to 10 percent, although a kiln equipped to blend the waste with other fuel prior to burning can handle higher levels. At high halogen loadings (greater than 10 percent) salts formed by reaction begin to fuse into a molten ring. The molten salts interfere with proper operation of the kiln and can cause shutdown if allowed to build up excessively. Also, halogen acid gases are corrosive to any metal parts of the kiln system (Stoddard et al. 1981).

Recovery of Hydrochloric Acid

Hydrochloric acid is commercially produced through destruction of chlorinated byproducts or wastes by incineration and subsequent scrubbing of combustion gases with water. For example, at one facility, chlorinated organic compounds are incinerated in a high performance burner, and the resulting hydrochloric acid gas is absorbed in water to produce a 21 percent hydrochloric acid, 79 percent water azeotropic mixture. A more concentrated acid (35 to 36 percent hydrochloric acid) is then produced by extractive distillation (Fox 1972). At two other facilities, over

90 percent of organic wastes are incinerated and the hydrochloric acid is recovered. At one plant, the acid is used to neutralize other wastes, and at another plant the acid is sold as a product.

C.3 Metal Recovery Technologies

Metal recovery processes can be divided into the following categories, representing a variety of unit treatment operations: metal concentration, metal reduction, metal substitution, and agglomeration. Many of the concentration, reduction, and substitution processes are widely used. Agglomeration techniques, however, have not been widely employed. Although many metal recovery operations are performed onsite (for recycling to a manufacturing or finishing process), commercial offsite recycling facilities also are available (see Offsite Recycling, Section 4.3 and Appendix C-6).

Agglomeration

Agglomeration is a term describing any process of gathering of small particles into larger particles, where the small particles still can be identified. Mill scale, sludges, and dusts generated by various industries (e.g., iron and steel industry) are agglomerated to be used for their metal values in blast or induction furances. Agglomeration avoids particulate carryover from furances. The agglomeration techniques commonly used for waste recycling include low temperature bonding, hot briquetting, direct reduction, and green balling.

- Low Temperature Bonding. In this process, the waste steam is blended with a binder and the mixture is formed into pellets by heat and/or pressure. Low temperature bonding processes differ in the type of binder used (see Table C-3).
- Hot Briquetting. Some metal wastes can be heated to a temperature between 1,600°F and 1,800°F in a fluidized bed and pressed into briquettes. These briquettes are cooled by heat exchange with the feed (Franklin Associates 1982a). This process is not widely used in the U.S.
- Direct Reduction. Wastes containing metal oxides can be mixed with coke breeze (coke particles having a diameter smaller than 0.5 inch) from iron and steel mills and formed into pellets. By a process called direct reduction, these pellets are preheated on a grate, then reduced (i.e., the metal oxides in the pellets are coverted to metals) in a rotary kiln, at a temperature of about 1,100°C, using coke as the reducing agent. The direct reduction process is used commercially only in Japan (Franklin Associates 1982a).

Table C-3 Summary of Recycling Technologies for Metals-Bearing Waste Streams

Type of process	Description	Applications	Limitations of Use
Metal concentration processes			
Hydrometallurgical processing (leaching)	Metals can be leached out of solids and sludges by extended contact with specific acids.	Extraction of metals from hazardous sludges, brine muds.	Concentration of desirable metals must be reasonably high (over 5,000 ppm) to make leaching attractive. Moderate cost of acids used is an economic constraint imposing lower limits on contents of waste to be handled.
Solvent extraction	Selective solvents used to extract and concentrate metal cations from aqueous solutions such as leachate.	Economically feasible for recovery of vanadium pentoxide. Evaporation of the amine solvent leads to recovery of reasonably pure ammonium vanadate.	Solvent losses can be a problem with some volatile solvents. High cost is not feasible for many metal-bearing wastes.
Ion exchange	Ion exchange resins are produced which will selectively remove certain metal ions but permit others to pass when wastewater is pumped through the packed bed.	Same as above	Expected life of resins is a concern in that frequent resin replacement will make the process more costly. Poisoning of resin with nonremovable impurities is also a major concern. For many applications the process is costly.
Precipitation	Metals dissolved in wastewater are precipitated out of solution by reacting them to form insoluble compounds.	Same as above; frequently used.	Recovered sludges need further processing to recover metal values.
Chemical reduction	Addition of reducing agents to waste solution containing toxic metals causes precipitation of elemental silver and mercury, or the reduction of Cr^{+6} to Cr^{+3}.	Recovery of silver or mercury in useable form from wastes. Converts hazardous CR^{+6} to nonhazardous Cr^{+3}.	Useful only for wastes containing easily reducible toxic constituents.

Table C-3 (continued)

Type of process	Description	Applications	Limitations of Use
Metal concentration processes (continued)			
Crystallization	Solid metal compounds removed from solution by cooling it, to lower solubility of metal salts.	Same as above. Used only in limited cases in which recovered material is saleable.	Practiced only for reasonably concentrated solutions, (i.e., above 20 percent concentration).
Calcination	Consists of reacting metal-bearing sludges at high temperatures to drive off water and other volatiles, incinerate residual organics, and oxidize remaining inorganic compounds including metals.	Converts waste to oxide that is easily handled as feedstock by a smelter. Used only in limited cases.	Not applicable to wastes containing arsenic or selenium, which form volatile oxides.
Evaporation	Concentration for recovery by evaporation. Widely used for chrome rinse tanks. Also used on rinse water from other plating operations.	Allows for recovery of concentrated solutions.	Energy costs place lower limits on concentrations to which technology is applicable. Used only in limited cases.
Membrane separation	Solids larger than pore openings in the filter media are removed. The openings must be smaller to achieve metal separations than those used in organics.	Allows for recovery of concentrated solutions. Rarely used because of higher costs.	Membrane materials must be selected based on their ability to withstand degradation by the waste; chromic acid and high pH cyanide baths have been particularly difficult streams to treat with this operation. Rarely used because of higher costs.
Adsorption	Similar to ion exchanges in selectively removing materials when wastewater is passed through a column of adsorptive media. Various natural materials including redwood bark and sphagnum moss are in commercial use for removal of various metals.	Removes metals from wastewaters. Not frequently used due to higher costs.	Recovery of metals from adsorbents such as high surface area clay or silica is difficult. Not frequently used due to higher costs.

Table C-3 (continued)

Type of process	Description	Applications	Limitations of Use
Foam flotation	Involves air flotation of foams after addition of polyelectrolyte and adjusting pH. Relatively new process - no commerical installations to date.	Effectively removes copper, zinc, chromium, and lead. Rarely used due to higher costs.	Raw material to process must be ore-like. Many waste types unacceptable as feeds. Rarely used due to higher costs.
Metal reduction and recovery			
Electrolyte recovery	Current passed through electrodes immersed in the metal solution. Metal ions migrate to the electrode where they give up an electron and are plated out.	Recovery of precious metals.	Process becomes inefficient when handling dilute solutions (concentrations below 100 mg/l.)
Sodium borohydride	Addition of sodium borohydride to neutral or alkaline solutions of metals will result in precipitation of the metallic powders out of solution.	Recovery of mercury from chloralkali production.	Process limited to recovering more noble metals, i.e., precious metals, nickel, cobalt, copper, and mercury. Process limited to salts for which metals are easily formed by reduction and to neutral or alkaline solutions. Used in limited cases due to higher operating costs.
Reduction in furnaces	Sludge is mixed with coke or other reducing agent and heated.	Metal refining	High cost limits this process to metal refining.
Other reducing processes	Copper can be removed from electroless solutions in metallic form by addition of formaldehyde and raising the pH. Copper will plate onto steel in acidic copper baths.	Recovery of material in metallic form.	Metal salt must be easily reducible. This limits process to precious metals, nickel, cobalt, copper, and mercury. Value of there covered material must justify cost of using the process. Used only in limited cases due to higher costs.

Table C-3 (continued)

Type of process	Description	Applications	Limitations of Use
Particulate and vapor recovery from gases			
Particulate recovery	Fine solid particles, entrained in baghouses and electrostatic precipitators (used in air pollution control) are recycled as feed in steel mills, or as source of trace metals to other industries.	Reduction of air emissions. Widely used, chiefly for control of air particulate emissions from metallurgical industries.	Material recovered is dry; wet material may be desired. Requires reasonably dry gas stream for suitable recovery.
Selective adsorbents	Adsorbent media are available commercially which selectively tie up specific metals. Adsorbents can be regenerated or destroyed to recover the metals. An example is the recovery of gold from cyanide-bearing solutions; gold is adsorbed from solution onto a resin. Incineration of the resin produces gold in useful form.	Reduction of air emissions.	Need to regenerate adsorbents or to dispose of sludges generated by spent adsorbent purification. Not widely used due to higher costs.
Wet scrubbers	Vapors and extremely fine particles can be recovered by wet systems such as packed scrubbing columns and impingement plate scrubbers.	Reduction of air emissions.	Need to treat or handle wastewater generated.
Retorting	Process used to recovery mercury from sludges; waste is heated in an oxidizing environment. Mercury is recovered by condensation.	Recovery of mercury and minimization of hazardous waste. If retorting is done properly, residue may be nonhazardous.	Energy-intensive operation. Value of recovered mercury may be insufficient to cover costs unless wastes with high mercury content are processed.
Metal substitution	Closed loop recovery system involving a replacement reaction between calcium and salt, added to Na-sludge in heated reaction vessel.	Recovery of sodium from waste sludge in sodium manufacture.	Only applicable to waste sludges from elemental sodium production.

Table C-3 (continued)

Type of process	Description	Applications	Limitations of Use
Agglomeration			
Low temperature bonding	Waste stream mixed with a binder; briquettes or pellets pressed out, which are then used as feedstock in metals operations (steelmaking, iron).	Allows for reuse of collected particulate materials.	Briquettes prepared by this method may not have desired integrity at elevated temperatures. Use of waste by metals procedure is probably preferable to any onsite use of such a process.
Hot briquetting	Feed material heated between 1600°F and 1800°F in fluidized bed, then pressed into briquettes.	Same as above.	Applicable only to solids with low vapor pressure at briquetting temperature. Process is not widely used.
Direct reduction	The process mixes, pelletizes, and preheats the waste stream on a grate and reduces the pellets on a rotary kiln by making use of the carbon in the pellets as the reductant.	Some oxide/hydroxide wastes from plating operations, if kept segregated by metals could be a useful feedstock for a smelter using such a process to convert ore to metal.	Useful only with easily reducible substances (i.e., some metal oxides). Recovered metal must justify cost. Process is used as part of smelting industry to reduce ores to metals. Shipment of waste to smelter in lieu of onsite processing is probably preferred.

- Green Balling. The green balling process, another agglomeration technique, recycles baghouse and electrostatic precipitator dust (air pollution control devices) from electric and open hearth furnaces of the iron and steel industry. The collected dust is wetted and formed into balls, which then are fed back into the furnace as a material feedstock.

Particulate and Vapor Recovery from Gases

Metals and metal compounds are recovered from air or gas streams usually as fine particles; however, more volatile metals (such as mercury, lead, cadmium, and zinc), which tend to vaporize in high-temperature processes, are recovered from the vapor phase.

- Particulate Recovery. Baghouses, electrostatic precipitators, and wet scrubbers are used in many industries to capture fine solid particles. These particles may be recycled to feed streams as in steel mills or may be a source of trace metals to other industries such as smelters in the nonferrous metals industries. Cadmium dust generated from cadmium batteries or pigment plants can be recycled (Versar 1980).

- Vapor Recovery. Metal vapors can be recovered by adsorbents that selectively tie up metals from gas streams. These commercially available adsorbents are regenerated or destroyed to recover the metals. Metal vapors also can be recovered by wet systems such as packed scrubbing columns or impingement plate scrubbers.

  The metals recovered by adsorption generally are disposed of rather than reused (personal communication with Dr. M. Caprini, Modux Corp., 1985). For example, in the production of phenol mercuric acetate, the process tail gases are passed through a carbon adsorption column for the removal of mercury, and the spent carbon (containing the mercury) is sent offsite to hazardous waste landfills or offsite reclaims.

  Retorting. This process is used in the chloralkali industry (SIC 2812) to recover mercury from mercury-bearing sludges and solid wastes. The waste is heated in an oxidizing environment. As elemental mercury forms, it distills from the waste and is collected by condensation. The residues from the retorting are shipped offsite as hazardous wastes. (Personal communication with Mr. Paul Tobia, Plant Manager, and Mr. George Gissell, Plant Environmental Coordinator, Vulcan Materials Inc., July 16, 1985).

Metal Concentration Processes

There are diverse methods available to concentrate metal compounds from a bulk solid or liquid into a sludge or solution. Unit operations for concentrating metals include hydrometallurgical processing (leaching), solvent extraction, ion exchange, chemical precipitation, calcination, evaporation, membrane separation, adsorption, and foam flotation. These processes have been developed either to recycle the metals or to treat the bulk stream to render it nonhazardous. The metal concentrates formed must be treated further to recover the metals in a usable (salable) form.

- Hydrometallurgical Processing. The primary application of hydrometallurgical processing (leaching) is for metals recovery from ores, but leaching technology also has been applied to the extraction of metals from hazardous sludges. Metals are leached from solids and sludges by extended contact with inorganic solvents. Then the dissolved metals are recovered by unit operations such as electrolysis, chemical reduction, or chemical precipitation followed by filtration, electrolysis, and ion exchange. Solvents used in hydrometallurgical leaching include sulfuric acid, hydrochloric acid, nitric acid, ammonia, ammonium carbonate, ferric chloride, and sulfur dioxide (Mehta 1981).

  Although the leaching of metals from hazardous sludges is not practiced widely, one such application is in the removal of mercury from contaminated brine muds generated from mercury cell chloralkali plants. Vulcan Materials Inc. (one facility at Port Edwards, Wisconsin) leaches contaminated muds with sulfuric acid to convert the solids to nonhazardous gypsum and to recover the mercury. Subsequent treatment of the leaching solution generates a much reduced volume of mercury-bearing wastes which is retorted to recover mercury (Personal communication with Mr. P. Tobiz, Vulcan Materials, 1985).

- Solvent Extraction. Organic solvents can be used similarly to extract and concentrate metal cations from aqueous or nonaqueous solutions (e.g., leachates). Commercial application of organic solvent extraction to recovery of metals is not common because of the high cost. One exception is the recovery of vanadium pentoxide from spent sulfuric acid catalysts (at two plants). The vanadium is leached from the catalysts, then selectively extracted from aqueous solution with a high molecular weight amine. Evaporation of the amine solvent leads to recovery of reasonably pure ammonium vanadate (personal communication with Dr. T. Hurst, Kerr-McGee Corp. 1980).

- Ion Exchange. Ion exchange columns are used extensively in large plating shops to remove metals such as cadmium, nickel, silver, and gold from wastewaters (Ploos Van Anstel and Frampton 1977). When metal-bearing wastewater is pumped through the column, the resins in the column remove certain metal ions but permit others to pass. The treated wastewater is recycled to the process as rinse water. The resin is regenerated with strong acid, which, in turn, is treated to recover the metals before reuse. By removing dissolved metals from an electroplating bath, the ion exchange column extends the service life of the bath.

- Precipitation. Toxic metals dissolved in wastewaters can be precipitated by addition of chemicals, usually lime or caustic soda. This conventional technology (hydroxide precipitation) has been improved upon by processes such as sulfide precipitation, which reduce the concentrtion of toxic metals in the treated wastewater.

  One commercial precipitation process removes metals from wastewaters through addition of a ferrous salt followed by neutralization and air oxidation. The ferrites formed from this treatment are insoluble over a wide pH range and easy to separate because of their magnetic properties and the size of the precipitate crystals. Information on commercial applications of this process was not available during this study.

  Nickel-plating solutions and spent-nickel catalyst are commonly recycled by the electroplating and inorganics chemical (SIC 2819) industries. Nickel-plating solutions are reacted with soda ash to precipitate nickel carbonate, which then is collected and reacted with sulfuric acid to generate an impure nickel-sulfate solution. This solution is purified from iron salts by addition of small quantities of sodium sulfide (iron salts are precipitated as iron sulfide). The solution is next separated from iron sulfide by filtration and evaporated to recover pure nickel sulfate. Spent-nickel catalysts, after being dissolved with a mineral acid to form a nickel salt solution, are treated the same way as the nickel-plating solutions. This recovery technology is currently used by at least two manufacturers of plating chemicals, Harshaw-Filtrol (personal communication with Mr. David Wilson, Manager of Environmental Affairs and Mr. Fred Kaplan, Business Manager of Industrial Chemical Products Division, Harshaw-Filtrol, Inc., Cleveland, Ohio, July 16, 1985) and C-P Chemical (personal communication with Mr. Vincent Krajewski, Director of Environmental Affairs, C-P Chemical Co., Sewaren, New Jersey, July 16, 1985).

  Another precipitation process uses cross-linked starch xanthate as the chemical additive. This process has a fast reaction rate and high removal rates of metals from waste solutions. It reacts rapidly to tie up the metals and leaves very low levels of most metals in the solution. The floc that settles rapidly can be dewatered to much lower levels than can be obtained with metal hydroxides. Subsequent treatment of the precipitate with acid releases the metals readily. This process is effective over a pH range from 3 to 11. The U.S. Department of Agriculture holds some patents, but others are also developing patented or proprietary improvements over this process.

Another application of chemical precipitation is for the recovery of spent hydrofluoric acid etching solutions at the Conservation Chemical Company, St. Louis, Missouri, facility. The spent etching solution is neutralized with potassium hydroxide, converting the heavy metal fluorides present into the corresponding insoluble hydroxides, which precipitate from the solution. The resulting potassium fluoride sludges are filtered to remove the hydroxide sludge which is disposed of (landfilled) as a hazardous waste. The remaining solution is evaporated to yield technical grade potassium fluoride for resale. Approximately 2,000 tons per year of this product are produced by this process (personal communication with H. Kaiser, Conservation Chemical Company, July 16, 1985).

- Chemical Reduction. In certain instances, chemical reduction is required prior to precipitation of metals. For example, to precipitate silver or mercury as metal, a reducing agent is added to the waste solution containing these metal ions. Hexavalent chromium is reduced to a trivalent state with a reducing agent such as sodium bisulfide or sodium metabisulfide. The trivalent chromium can then be precipitated in the form of a hydroxide. It has been proposed that the hydroxide sludge can be treated with sulfuric acid to recover chromium sulfate, which can then be used in the leather tanning industry. Precipitation processes are widely used in the inorganic chemical, electroplating, and metal-finishing industries.

- Crystallization. Crystallization of metal ions from a waste solution occurs as the temperature of the solution is lowered. This transformation takes place because metal compounds have lower solubility at colder temperatures. Crystallization commonly is used to recover ferrous sulfate from waste pickle liquors or from sulfate process titanium dioxide waste acid solutions. The acid is pumped to a crystallizer where the temperature is maintained at approximately 35° to 40°F to crystallize ferrous sulfate heptahydrate ($FeSO_4 7H_2O$) from the solution. Crystallization also is used to regenerate copper etching baths for reuse. The baths (with hydrogen peroxide and sulfuric acid) are regenerated by refrigeration and freezing of the copper sulfate crystals out of the solution.

- Calcination. Calcination drives off water and other volatiles from metal-bearing sludges by exposure to high (incineration) temperatures. The residual organics in the sludge are combusted during the process, and any remaining inorganic compounds (including metals) are oxidized. Leaded tank bottoms are treated by calcination to recover lead oxide (Stoddard et al. 1981).

- Evaporation. Evaporation is used to concentrate rinse water from plating operations (nickel, cadmium, copper, chromium, silver, gold, and zinc), yielding distilled water and a metal concentrate that are recycled to the rinse tanks and plating tanks, respectively (Warnke et al. 1977, Bhatiz and Jump 1977, Elickerr and Lacy 1978, and Caprio et al. 1977). Additional metal recovery steps may be necessary. For example, solutions from chromium rinse tanks that are first concentrated by evaporation are passed through ion exchange columns to recover the chromium that is recycled to the plating baths.

- Membrane Separation. Membrane separation processes include reverse osmosis, ultrafiltration, and electrodialysis. The membranes serve as a medium for separating metals and other dissolved species from water and small molecular species. In reverse osmosis and ultrafiltration separation processes, the waste solution is forced through the membrane by pumping. In electrodialysis, an electrical potential is applied across the membrane, causing the transport of either cations or anions through the membrane.

  Reverse osmosis membranes have smaller pore openings and operate at higher pressures. Membrane materials must be selected based on their ability to withstand degradation by (corrosive) wastes. Pretreatment of the waste is needed to reduce plugging and fouling of the membrane. Reverse osmosis is frequently applied to the recovery of metals from copper and zinc plating solutions, silver-bearing photoprocessing solutions (Daignault 1977), and mixed plating wastes. Ultrafiltration membranes used for organics can remove suspended, colloidal, and large molecular dissolved solids. This separation technique can, therefore, serve as a pretreatment for metals.

- Adsorption is similar to ion exchange in selectively removing materials when wastewater is passed through a column of adsorptive media; however, this process involves a looser bond between the surface of the media and the metal being removed. (In ion exchange resins, there is an actual chemical group replacement in the complex molecular structure of the resin.)

  Various natural materials, including redwood bark and sphagnum moss, are used commercially for adsorbing metals from solution, and synthetic adsorbents, first commercialized in Japan, are also used in the U.S.

  Synthetic adsorbents are regenerated by passing an acid through the column. Alternatively, the adsorbent may be incinerated, leaving an ash-metal oxide concentrate.

  Foam flotation is a new process, which involves air flotation of foams after addition of polyelectrolyte and pH adjustment. Foam flotation effectively removes copper, zinc, chromium, and lead from waste solutions (WPCF 1983). Although the economics of this process are claimed to be favorable (WPCF 1983), no commercial installations were identified during this report.

Metals Reduction and Metals Recovery

Metals reduction and recovery operations include electrolytic recovery, chemical recovery with sodium borohydride, and reduction in metal furnaces and through other processes. Wastes must be concentrated by one of the methods described above prior to application of reduction and recovery operations.

- Electrolytic Recovery is the most conventional commercial metals reduction process, where current is passed through electrodes immersed in the metal solution. Metal ions migrate to the cathode (negative terminal) to be reduced to their elemental form (by giving up an electron) and are plated out. The reaction at the anode (positive terminal) generates oxygen to complete the oxidation-reduction reaction. The deposited metal can be peeled off the cathode and sent to a refiner or, if the cathode is made of stainless steel, it can be directly used as an anode in a plating tank. Battelle Columbus Laboratories and Rolla Metallurgy Center have developed an electrolytic process that removes copper from a mixed-metals leachate. After removal of copper, the chromium and zinc which remain in the leachate are recovered by roasting. Silver has also been electrolytically recovered from spent photographic development solutions (Daignault 1977).

- Chemical recovery with Sodium Borohydride. A recently developed process involves addition of sodium borohydrate to neutral or alkaline solutions of metals, and precipitation of metals by reduction in their elemental form. No additional treatment is required except for filtration of the precipitated metals from the solution. The metals after filtration can be sold directly to scrap metal dealers.

  Chemical recovery with the sodium borohydride process is acquiring wide acceptance for treatment and recycling of metals in various industries. This process has been used to recover mercury from chlor-alkali production wastes, and precious metals from spent photographic fixer and plating solutions (*Business Week* 1974, Medding and Lander 1981).

  This process has a very low capital requirement, but is relatively high in operating costs because of the cost of sodium borohydride. The use of this process is limited to neutral or alkaline solutions, because sodium borohydride may cause an explosive reaction in acidic solutions (*Business Week* 1974).

- Reduction in Furnaces. Metal refiners recover metals directly from certain sludges in reduction furnaces. This operation is very similar to the recovery of metals from ores in furnaces.

The sludge is mixed with a reducing agent (usually coke) and charged into the furnace. The metallic compound is reduced to the metal, while the coke is oxidized to carbon monoxide and carbon dioxide. The high capital investment limits application of this technology to metal refiners.

- Other Reduction Processes. Other reduction processes are also commercially available in limited applications. For example, copper can be removed from alkalone electroless solutions in metallic form by addition of formaldehyde. Copper can also be removed as metal from acidic copper baths if steel sheets are placed into the solution. In this application, iron cations replace copper in the solution.

Metal Substitution and Recovery

A byproduct sludge containing sodium, calcium, and their oxides, results from the manufacture of sodium metal. The sodium metal is recovered from the sludge using a closed loop recovery system and returned to the sodium process as usable finished product (DuPont 1985).

The recovery process involves a replacement reaction between calcium and salt, which is added to the sludge in a heated reaction vessel. The reaction converts the calcium into calcium chloride and yields recoverable sodium metal.

The sodium recovery process at DuPont results in approximately 1,100 tons of usable sodium being recovered per year. Additionally, approximately 1,200 tons of RCRA hazardous wastes are eliminated per year. The process results in the generation of 800 tons per year of nonhazardous waste, which is disposed of in an approved sanitary landfill.

A somewhat different, proprietary process is used at the RMI sodium facility. There, also, waste sodium-bearing sludge is reprocessed to recover the metal.

Process Substitution

In a few cases, it is possible to substitute the use of a new process to entirely avoid generation of hazardous waste. The premier case of this situation exists in the chloralkali industry. Up until 1980, all high-purity sodium hydroxide was produced by the mercury-cell process, which generates mercury-bearing solid wastes. A new process, the membrane cell, has been developed by DuPont. The process also produces high-grade caustic soda at lower cost than the old mercury-cell process. In the membrane cell, chlorine is formed at the anode and sodium ions migrate through a membrane to undergo further electrolytic reaction with water in the cathode compartment, thus forming sodium hydroxide and hydrogen. Five membrane cell plants have been built since 1980 in the U.S. All of them are fairly small and use either evaporated salt or salt recovered for onsite diaphragm cell operations as feedstock. In April 1985, DuPont announced construction of a new 1,000 ton-per-day membrane cell plant at Niagara Falls, New York, to open in mid-1987. According to data supplied by DuPont (personal communication and material submitted by Dr. John Cooper, Petrochemicals Department, E. I. duPont de Nemours, Inc., Delaware, October 2, 1985). The plant design calls for the following features:

- Zero production of hazardous waste;
- Total recycling of spent brines to the brine wells for solution mining of raw salt material;
- Production of hydrochloric acid from chlorine present in process tail gases; and
- Total sale of the spent sulfuric acid used in chlorine drying.

The effect of the construction of this new plant on the industry has already manifested itself. Recently, Olin Corporation (Wall Street Journal, September 27, 1985) announced the closure of their mercury cell plant located in Niagara Falls, New York, because they do not feel their plant can be competitive with the new DuPont facility under construction. Should the new facility meet industry expectations, a further expansion of membrane cell capacity is to be expected. This may be accompanied by a further decline in the amounts of mercury-bearing hazardous wastes generated.

The number of cases in which new process developments have the potential to eliminate hazardous waste has been small. In cases in which they do occur, such as for the membrane cell, their effect on future hazardous waste generation may be substantial.

C.4 Recycling Technologies for Corrosive Wastes

Corrosive wastes that are recycled include spent acids and alkalis from chemical manufacture and petroleum refining processes, and also the acid from spent pickle liquor. Technologies commonly used to recycle corrosive wastes include thermal decomposition, evaporation, crystallization, ion exchange, and oxidation. The limitations and uses of each of these technologies are presented in Table C-4 and discussed below.

Thermal Decomposition

Thermal decomposition is used in the recovery of sulfuric acid from spent acid sludges to recover ferric chloride from acidic titanium dioxide waste and for the recovery of hydrochloric acid from spent pickle liquor or halogenated organic residues.

- Recovery of Sulfuric Acid. Thermal decomposition is widely used in petroleum refineries to recover concentrated sulfuric acid from spent alkylating acid sludges contaminated with hydrocarbons and containing water. The acid sludges are recyucled by spent acid processors in evaporators at temperatures ranging from 2,000° to 2,300°F. Mixed sulfur dioxide and water vapors produced from decomposition of the sludge are passed through a dust collection chamber for particulate collection, a waste-heat boiler for heat recovery, and a heat exchanger to lower the temperature to 700°F. The water vapor is removed from the gas by 93 percent acid and the sulfur dioxide is oxidized to sulfur trioxide in the presence of vanadium catalyst. Finally, the sulfur trioxide gas is scrubbed with strong acid in an absorption tower to yeild 98 to 99 percent sulfuric acid (Versar 1980).

- Recovery of Hydrochloric Acid from Pickle Liquor. Iron and steel mills (SICs 331 and 332) generate a spent pickle liquor (RCRA Code K062) that contains approximately 20 percent ferrous chloride and 5 percent hydrochloric acid. Recovery of the hydrochloric acid by thermal decomposition could be practiced by many of these facilities.

  The first step in the recovery process is the preheating and concentration of the spent pickle liquor in evaporators. This concentrated solution is introduced into a hydrolysis reactor. The reactor, operating at approximately 1470°F to 1830°F, creates an oxidizing environment for the reaction between ferrous chloride and water. Ferric oxide solids are produced and precipitate out of the solution.

Table C-4 Summary of Recycling Technologies for Corrosive Waste Streams

Type of process	Description	Applications	Limitations of Use
Thermal decomposition			
Recovery of HCl	Hydrochloric acid containing dissolved ferrous chloride from pickling is reacted with water in the presence of heat to yield hydrochloric acid and ferric oxide.	Recovery of HCl for reuse.	Hydrolysis of $FeCl_2$ requires a considerable input of energy; iron oxide becomes a waste, needing disposal. Use of $FeCl_2$ to produce ferrous/ferric chlorides for sale, where viable, is preferred. (Not widely used due to higher cost.)
Recovery of H_2SO_4	Concentrated sulfuric acids contaminated by water and hydrocarbons are burned at high temperatures. Gases are passed through dust collection chamber, dried by 93% acid, and the SO_2 present is oxidized to SO_3 in the presence of a vanadium catalyst. The SO_3 is scrubbed with acid to yield 98 to 99% H_2SO_4.	Allows for recovery of sulfuric acid. Widely used to recover spent sulfuric acid from refineries.	Transportation may be a constraint. The facility regenerating the acid needs to be nearby to minimize shipping cost. Process is costly to operate with small volumes, but economical with large volumes.
Evaporation	Involves removal of water from the waste by evaporation leaving a concentrated solution behind.	Recovery of alumina from bauxite; recovery of sulfuric acid in nitrobenzene production; concentration of phosphoric acid (fertilizers) and chromic acid (plating baths).	Only applicable to concentration of low-volatility acids. Will not remove nonvolatile contaminants. Used only in selective cases where acids are of higher value.

Table C-4 (continued)

Type of process	Description	Incentives	Constraints
Crystallization (continued)			
Recovery of ferric sulfate or ferric chloride from pickle liquor	Solution cooled to induce crystallization. Crystals separated from the acid by centrifugation for disposal or marketing. Acid returned to the pickling tank.	Recovery of ferric sulfate or ferric chloride allows for recovery of iron salts.	Limited market for recovered iron sulfate that must compete for markets with iron sulfate derived as a byproduct from titanium dioxide production. Acid not recovered.
Caustic soda from aluminum etch	Caustic soda is recovered by continuously pumping the etchant to a crystallizing tower, where precipitation occurs in a controlled manner.	Process removes alumina from the caustic to then be reconcentrated for reuse.	Impurities other than aluminum will not be removed. Not widely used in the U.S.
Ion exchange	Process employs a resin that selectively adsorbs acids and rejects metallic contaminants. The bed is then flushed with water to displace the absorbed acid for reuse.	Regeneration of electroplating, metal finishing, and fertilizer manufacturing wastes.	Oxidizing agents (acids) may degrade the ion exchange resins, leading to a product acid contaminated with organics. Process is costly and not widely used.
Oxidation	KEL CHLOR® process reacts HCl with O_2 at 170° to 400°C, nitric acid catalyst in reaction system with 2 liquid-gas contactors with a homogeneous gas-phase reactor between them. Chlorine purified by absorption and drying with sulfuric acid.	Recovery of chlorine from hydrochloric acid.	Application only to waste HCl that is gaseous.

Any particulates present in the hydrochloric acid gas from the reactor are removed in a cyclone. The hydrochloric acid is next cooled and absorbed with water to form a 20 percent acid solution. Ferric oxide particles collected from the reactor and cyclones are recycled at the iron and steel mills.

Although recovery of hydrochloric acid from pickle liquor is a capital-intensive operation, the value of the recovered acid could be substantial. At present, however, industry practice is geared toward recovery of iron chlorides from this waste (K062). This is achieved by reacting the waste with iron, converting the pickle liquor to an iron chloride solution free of unreacted HCL. The iron chloride is then marketed. Conservation Chemical in Gary, Indiana, uses such a process, as do some of the larger steel companies (personal communication with Mr. Howard Kaiser, Conservation Chemical, July 16, 1985).

- Recovery of Halogenated Acids from Halogenated Organics. This recovery operation was discussed previously under recycling of halogenated organics (Section C.2). It involves incineration of halogenated organics and water scrubbing of the combustion gases to recover halogenated acids. Because the intent of the operation is the disposal of halogenated organics by incineration, any recovered halogenated acid is a byproduct of the process, with low capital costs and no raw materials costs.

- Recovery of Ferric Chloride from Acidic Titanium Dioxide Wastes. DuPont recovers about 100,000 tons per year of saleable ferric chloride from the wastes generated by their chloride process titanium dioxide plant in Edgemoore, Delaware. The technology used includes partial evaporation of a highly acidic wastewater stream. Ferric chloride crystallizes from the concentrated liquor, is recovered, dried, and sold as a solid product.

  Use of this technology has provided DuPont with an additional product line and has saved DuPont the cost of having to neutralize large volumes of aqueous ferric chloride solutions (personal communication with Mr. John Cooper, E. I. DuPont du Nemours, Inc., October 2, 1985).

  According to DuPont, the technology is constrained in its further application by limited markets for ferric chloride. The Edgemoore facility presently produces about 40 percent of the U.S. ferric chloride. This process, in fact, is not used at other DuPont titanium dioxide plants because of market lilmitations for ferric chloride. Furthermore, ferric chloride recovered from titanium dioxide process wastes currently competes with the material recovered from waste pickle liquor from the steel industry.

Evaporation

Evaporation involves vaporization of water from a liquid waste that leaves behind a concentrated solution. Both atmospheric and vacuum evaporators are used to concentrate corrosive wastes. Atmospheric evaporation can be achieved by boiling the waste solution or by heating the waste solution (to a temperature below its boiling point) to enhance the transfer of water from the waste solution into a sweeping air stream. Evaporation under vacuum is also commonly performed to remove water at reduced temperatures. Evaporation is applicable only to concentrated corrosive acids or bases with low volatilities. Examples of corrosives concentrated by evaporation are sodium hydroxide, phosphoric acid, and chromic acid. Evaporation is not applicable for volatile corrosives such as hydrochloric acid and ammonia. Use of evaporation to recover sodium hydroxide for reuse is found in the aluminum industry (Versar Inc. 1980; USEPA 1979).

- Caustic Soda Concentration by Evaporation. For the recovery of alumina from bauxite, hot caustic soda (sodium hydroxide) is used to dissolve alumina as sodium aluminate. After removal of insolubles by filtration and precipitation of aluminum, the caustic solution is concentrated by evaporation and the concentrate is reused in the process (USEPA 1979).

- Nitration Acid Recovery by Evaporation. Spent acid containing 70 percent sulfuric acid is generated from production of nitrobenzene by reacting benzene with nitric acid in the presence of sulfuric acid. After removal of organic impurities by stripping, the spent acid is concentrated by evaporation for reuse in the nitration process (personal communication with Dr. John Cooper, Petrochemicals Department, E. I. duPont de Nemours, Inc., Wilmington, Delaware, October 2, 1985).

  To avoid the concentration of impurities in the recycle loop, about 5 percent of the spent acid (after stripping) is purged. This purged acid is sold to the fertilizer industry as a commodity. An additional 5 percent of the acid (after stripping) is used to neutralize acidic streams from the plant. Ten percent fresh acid is added to the recycle stream to replace that which was purged and used to neutralize the acid.

  The economic incentives for reconcentration and reuse are commodity costs for once-through sulfuric acid, transportation and handling costs, selling expense for spent acid, and working capital invested in inventories. If the once-through spent acid were not marketable, the additional cost of neutralization would increase the incentive to reconcentration and reuse.

The obstacles to reconcentration and reuse of spent acid are basically economic. Large investments in equipment and environmental controls are required, and high maintenance and employee protection (safety) costs are inherent in the sulfuric acid concentration process.

- Phosphoric Acid Concentration by Evaporation. Phosphoric acid is concentrated to standard acid strength by evaporation under vacuum. This is normally practiced in the production of wet-process phosphoric acid in the fertilizer industry (Versar 1980).
- Chromic Acid Concentration by Evaporation. Evaporation is used to concentrate chromic acid from plating-rinse tanks from the metal plating industry. The concentrated solution is then reused in plating baths. This technology has been proposed for use in its electroplating industry. Its current degree of use is not known.

Crystallization

Corrosive wastes that are recycled by crystallization include pickle liquors (for recovery of ferrous sulfate and ferric chloride) and aluminum etch (for recovery of caustic soda). Acid solutions containing copper also may be regenerated by this method.

- Recovery of ferrous sulfate from pickle liquors. Iron salts (mainly ferrous sulfate) are crystallized from pickle solutions to recycle sulfuric acid to pickling baths in metal finishing processes. Crystallization of iron salts in pickle liquor can be induced by direct cooling of the solution or by indirect cooling through the application of a vacuum and the evaporation of water from the solution. Commercial processes use either direct cooling, indirect cooling, or combinations of these two techniques in batch or continuous modes of operation.

  For direct cooling, the solution temperature is slowly reduced by 35° to 50°F to crystallize ferrous sulfate heptahydrate ($FeSO_4 \cdot 7H_2O$) over a period of 8 to 16 hours. The slurry is then passed to a collection chamber, which retains the crystals but allows the pickle liquor to pass through an acid recovery tank. The crystals are washed with water to remove free acid and then dried by drawing air from the crystal bed. The crystals are either disposed of or sold, and the pickle liquor is either reused in the pickling tanks or neutralized and discharged.

For indirect cooling, the pressure in the crystallizer is reduced to allow evaporation of water, which in turn cools the liquid and enhances crystallization of $FeSO_4 \cdot 7H_2O$. Separation of crystals from the pickle liquor can be achieved by centrifugation.

Recovery of ferrous sulfate by crystallization is used in large steel mills, where the capital cost for a package unit is justified by the large volume of pickle liquor recovered and reused. The ferrous sulfate separated from this process is of adequate quality for use as a flocculating agent in wastewater treatment plants. Besides the size of the recovery plant, process economics are highly dependent on the value of ferrous sulfate recovered, disposal costs, and availability of a market for ferrous sulfate.

- Recovery of Ferric Chloride from Spent HCl Pickling Solutions. A somewhat similar process exists and is used to recover ferric chloride from spent hydrochloric acid pickling solutions. There, the spent pickle liquor is reacted with iron to yield a ferric chloride solution free of hydrochloric acid for sale (Versar 1980).

  This process has a limited economic appeal for the metal finishing industry, which consists of a large number of manufacturers each generating small amounts of spent pickle liquor. For such small manufacturers, neutralization and land disposal of wastes appear to be more attractive. In either case, the process is generally limited to recovery of iron salts. Reconcentration of the residual acid is energy-intensive and not practiced.

- Recovery of Caustic Soda from Aluminum Etching Solutions. A process developed by Fuji Sash Industries of Japan for the recovery of caustic soda (NaOH) from aluminum etching solutions has been commercially available in the U.S. since about 1980. During aluminum etching, caustic soda reacts with aluminum to form sodium aluminate ($NaAlO_2$), which normally tends to hydrolize, yielding NaOH and $Al(OH)_3$, (hydrated alumina or aluminum hydroxide). To prevent precipitation of $Al(OH)_3$ on the heating coils and walls of the etching tank, chelating agents, such as sodium gluconate, are added into the solution.

  Caustic soda is recovered by continuously pumping the etchant to a crystallization tower, where $Al(OH)_3$ is precipitated in a controlled manner. The recovered caustic soda is then returned to the etching tank. The $Al(OH)_3$ crystals withdrawn from the bottom of the crystallizer are dewatered by means of a centrifuge, and the centrifugate is returned to the etching tank for reuse.

  This recovery operation can reduce caustic soda purchases by 80 percent. The hydrated alumina crystals produced are equivalent to commercial grade and can be a source of income provided a market is found. However, this operation is not widely used in the U.S.

- Recovery of Sulfuric Acid/Hydrogen Peroxide from Copper-Cleaning Solutions. Regeneration of an acid solution for copper cleaning is commonly accomplished by crystallization of copper sulfate and removal of the crystals. This process is used by printed circuit manufacturers and metal finishers. The value of the recovered copper salts justifies use of the process.

Ion Exchange

Ion exchange resins can remove heavy metals and cyanides from acid and base solutions. The purified solutions can then be reused in the manufacturing process. The ion exchange technology has found application in regenerating waste solutions from the electroplating, metal finishing, and fertilizer manufacturing industries.

In this process, the ion exchanger is contacted with the solution containing the heavy metal or cyanide ion to be removed. When the ion exchanger is exhausted (i.e., the active sites are partially or completely used up by the ion to be removed), it is regenerated with a concentrated solution of the ion originally present in the exchanger. Although this process regenerates a spent acid or base solution, the undesirable ions present in the original solution are transferred into another solution (in a more concentrated form) that requires further treatment or disposal.

A recent ion exchange process developed by Eco-Tech Ltd. of Canada (Pickering, Ontario) purifies acid solutions by ion exchange without producing a waste regenerant stream. This process uses a resin that selectively removes acids and rejects metallic contaminants. Metallic salts pass through the resin bed and are collected. The bed is flushed with water to displace the acid for reuse. This process has been used in numerous installations since the mid 1970s.

Oxidation

Byproduct hydrogen chloride can be oxidized to produce chlorine via the Kel-Chlor® Process jointly developed by M. W. Kellogg and DuPont (DuPont, 1985). The chlorine is then used to produce chlorinated hydrocarbons.

- In the Kel-Chlor® Process, the hydrogen chloride is reacted with oxygen at 170°C to 400°C and 15 atm (210 psig) in the presence of a nitric acid catalyst. The oxidation reaction is:

$$2\,HCl + 1/2\,O_2 \xrightarrow{HNO_3} Cl_2 + H_2O$$

  The reaction system utilizes a unique combination of two liquid-gas contactors with a homogenous gas-phase reactor integrated between them. Recirculating sulfuric acid removes the heat of reaction and water from the contactors. The recirculating acid is also used to trap the catalyst, oxides of nitrogen, between the two contactors. Reducing the pressure on the sulfuric acid before recycling flashes off the water and removes the reaction heat.

  Chlorine from the second contactor is then purified. The purification system involves absorption and drying by sulfuric acid, followed by condensation to produce dry chlorine. Waste hydrochloric acid and chlorine from vents are recovered by absorption with carbon tetrachloride. The Kel-Chlor® Process has a 97 percent conversion of hydrochloric acid and 99.7 percent yield. DuPont operates the process at their Corpus Christi, Texas, facility.

- Dow Chemical at Freeport, Texas, reacts byproduct HCl with magnesium oxide produced onsite to generate magnesium chloride. This magnesium chloride is then electrolyzed in the molten state to yield magnesium metal and chlorine gas. The magnesium metal is sold as a product, and the chlorine is reused onsite to produce chlorinated organic compounds (Versar 1979).

The DuPont, Mobay, and Dow facilities all generate large volumes of unsalable byproduct hydrochloric acid. The large volumes of acid generated justify the costs of installing conversion-to-chlorine technologies (Versar 1989). These technologies probably are unsuited, however, for plants generating relatively small volumes of waste HCl. Current production capacities for the three plants are as follows (SRI 1985):

DuPont (Kel-Chlor®)	216,000 metric tons/year chlorine
Moby (Electroelytic)	82,000 metric tons/year chlorine
Dow (Magnesium)	343,000 metric tons/year chlorine

C.5 Cyanides and Other Reactives

Cyanides

Cyanide wastewaters generated from precious metal (e.g., gold, silver) beneficiation are commonly recycled.

- Gold Beneficiation. In gold beneficiation, the crushed ore is contacted with a cyanide solution to dissolve gold. The slurry is next filtered to separate the insolubles from the cyanide solution. Gold from the solution is recovered by precipitation with zinc dust or by adsorption onto activated charcoal. Most of the resulting gold-free solution, which contains free cyanide and cyanide complexes of various metals (e.g., copper, iron, nickel, zinc, arsenic, antimony, silica), is recycled as a filter cake wastewater to displace and recover additional gold. The remainder of the gold-free solution is discharged after treatment.

- Limitations of Recycling Cyanide Solutions. Cyanide solutions from other industries are not commercially recycled. For example, a study by the California Department of Health reports that no commercial recycling of cyanide is practiced in California. The common management practice for contaminated cyanide rinse waters (with concentrations less than 100 mg/l) from metal finishing operations is destruction by chemical oxidation before discharge to municipal treatment plants. The major reason for this practice is the low cost of fresh cyanide. Land disposal of cyanide wastes is no longer possible as an option because it was banned by EPA several years ago.

- Potential Recovery Techniques. Techniques that potentially can be used for recovering and recycling cyanide solutions from metal plating (e.g., zinc, cadmium, brass, and silver plating) operations include refrigeration/crystallization, evaporation, ion exchange, and membrane separation (reverse osmosis or electrodialysis). Among these techniques, refrigeration/crystallization was proposed and patented by the Department of Defense (U.S. Patent No. 4,365,481) to recover and recycle cyanide from plating solutions that contain excessive amounts of sodium carbonate (carbonate to cyanide weight ratios greater than 6:1). The process involves cooling of the cyanide plating bath liquid via heat exchange with a cold surface (e.g., a tin box filled with dry ice and acetone inserted into the liquid) to form sodium carbonate crystals on the cold surface. With the removal of the cold surface from the solution, cyanide is freed from sodium carbonate and made ready for reuse in subsequent plating operations. Although some members of the electroplating industry have found this patented process to be promising, they believe that its widespread use is limited because of the formalities involved in obtaining the necessary permission from the Department of Defense. The limitation for the other above-mentioned recovery techniques is mainly economic.

Reactives

The primary barrier to the recycling of most water-reactive wastes (e.g., most alkali metals) is technical. In specialized applications of alkali metals, such as lithium, where high purity is critical (metal hydrides, lithium batteries, etc.), recycling of purified wastes is impractical because contamination with oxides, dirt, oil, etc., affects product quality and plugs pumping equipment used for molten materials. The most common disposal method for water-reactive wastes is incineration; however, it is expensive (over $25 per pound plus transportation) and is conducted by only a small number of permitted disposal companies. Available technologies for recycling reactive wastes are discussed below.

- Ammonium Perchlorate Separation by Filtration - Evaporation. Research is underway at DOD facilities to investigate the feasibility of recovering and recycling reactive wastes. For example, at Indian Head Naval Ordance Station (NOS), recovery and recycling of reactives from a demilitarization facility is being evaluated. This facility houses equipment that uses high pressure water to remove propellant (containing ammonium perchlorate, aluminum, RDX (cyclotrimethylene base trinitramine), HMX (cyclotetrametaylene tetranitroamine), and HBNQ (high bulk nitro guanidine) from rocket cases, which are then reused. A screen in the case-reclamation tank is used to remove large propellant particles. The effluent from the case-reclamation tank is introduced into a baffled tank where small particles are settled. The overflow from the baffled tank, containing approximately 0.3 percent AP (ammonium perchlorate), is currently discharged through a filter located at the end of the discharge pipe. Plans are underway to eliminate this discharge. The proposed operation involves concentration of the ammonium perchlorate solution to 12 percent, evaporation of this concentrated solution, and sale of the recovered AP (with 10 to 20 percent moisture content) to a contractor.

- Separation of Propellants Constituents by Solubilites. Research is also underway at Indian Head NOS to recover RDX and HMX from demilitarization operations. The technique for separating these propellant ingredients is based on differences in solubility: ammonium perchlorate and inorganics are soluble in hot water; RDX is insoluble in water, but soluble in acetone; HMX is insoluble in water and acetone, but soluble in dimethyl sulfoxide (DMSO) and dimethyl formamide (DMF). Recovery of HMX from acetone is possible by evaporation of acetone. Removal of HMX from a DMSO or DMF solution can be achieved by crystallization followed by liquid-solid separation. In addition, research programs are being conducted at the Army Armaments R&D Center (Dover, New Jersey) and National Research Laboratory (Oak Ridge, Tennessee).

- Sodium. Waste sodium is recovered from wastes from the Downs Cell Process for sodium manufacture. The technology used was discussed earlier under metal recovery (Section C.3). Ventron, a manufacturer of sodium borohydride, accepts sodium waste for reprocessing by this process to recover sodium. About 600 tons/year of impure sodium waste are returned for reprocessing.

- Ignitable Wastes. Recycling of ignitable materials for these materials is very limited. One case where recycling is documentable is in the production of elemental phosphorus where phossy wastes are generally retorted to recover additional phosphorus. The use of retorting technology is common practice in the phosphorus industry.

- Magnesium. A second case of documented recycling of reactive wastes is the production of magnesium chemicals from wastes containing low levels of magnesium at the Mineral Research and Development Corporation, Harrisburg, North Carolina (personal communication with Mr. J. T. Rose, Mineral Research and Development Corportion, December 17, 1985). The company formerly shipped these wastes for disposal but now reuses them to recover the magnesium values. The recovery process involves digestion of magnesium in dilute mineral acid to generate solutions of magnesium salts for agricultural applications.

C.6 Summary Data on Offsite Recycling Practices

This appendix presents detailed information tc supplement the overview of offsite recycling practices provided in Section 4.3 of the report. Table C-5 lists the number of recycling, recycling-and-treatment, and treatment-only facilities in each State. These data support the observation made in Section 4 that recycling facilities are clustered in the more industrialized States. Table C-6 presents the distribution of recycling and treatment facilities available to or located in each State according to the type of treatment process, including solvent recovery, resource recovery, mobile treatment, PCB services, and thermal treatment facilities. With the exception of Alaska, which is not served by mobile treatment facilities, all States are served by at least one facility in each category.

Supplementary information on wastes recycled through waste exchanges is presented in Tables C-7 and C-8. Table C-7 lists solvent, metal, corrosive, halogenated organic, and cyanide/reactive wastes by waste exchanges. The wide range of requested halogenated and nonhalogenated solvents, metals, and corrosive wastes suggests a market for offsite recycling. The absence of cyanide/reactive wastes from the lists is consistent with the dominance of onsite recycling of wastewater treatment sludges from electroplatng operations (F006), the only cyanide/reactive waste category that is recycled in high volume. Similarly, reuses for halogenated organic wastes (e.g., pesticides, PCB-contaminated dielectric and hydraulic fluids) are confined to onsite applications; such wastes are therefore unlikely to be recycled through waste exchanges.

Table C-8 is a summary of materials recycled through three major waste exchanges and the associated time period, quantity of waste, value, and distance each waste was transported for recycling. Although the total volume of waste recycled is small relative to the total volumes of hazardous waste generated and recycled during this period, this profile of wastes recycled represents the establishment of a mechanism for continued recycling of similar types of wastes by the users of the exchange.

Table C-5 Number of Recycling and Treatment Facilities by State

	Number of facilities			
	Recycling only	Recycling and treatment	Treatment only	Total
Alabama	4	3	1	8
Alaska	0	0	0	0
Arizona	1	3	0	4
Arkansas	3	3	0	6
California	25	31	6	62
Colorado	4	1	0	5
Connecticut	10	6	5	21
Delaware	3	3	0	6
Florida	1	3	2	6
Georgia	5	6	2	13
Hawaii	1	0	0	1
Idaho	4	1	0	5
Illinois	20	19	6	45
Indiana	20	10	2	32
Iowa	3	0	1	4
Kansas	4	3	0	7
Kentucky	4	8	1	13
Louisiana	5	6	1	12
Maine	1	1	0	2
Maryland	6	6	0	12
Massachusetts	12	8	2	22
Michigan	7	10	7	24
Minnesota	10	1	0	11
Mississippi	4	1	0	5
Missouri	18	3	2	23
Montana	0	0	0	0
Nebraska	1	2	0	3
Nevada	1	0	0	1
New Hampshire	2	1	0	3
New Jersey	9	12	6	27
New Mexico	0	1	0	1
New York	12	16	2	30
North Carolina	8	4	4	16
North Dakota	0	0	0	0
Ohio	23	18	11	52
Oklahoma	2	3	2	7
Oregon	3	5	0	8
Pennsylvania	21	13	5	39

Table C-5 (continued)

	Number of facilities			
	Recycling only	Recycling and treatment	Treatment only	Total
Rhode Island	6	3	0	9
South Carolina	4	6	0	10
South Dakota	0	0	0	0
Tennessee	10	8	2	20
Texas	15	21	11	47
Utah	2	1	0	3
Vermont	2	0	0	2
Virginia	4	3	2	9
Washington	8	7	1	16
West Virginia	1	0	0	1
Wisconsin	5	4	2	11
Wyoming	0	0	0	0
Puerto Rico	3	1	0	4

Source: EPA/530-SW-85-019. Aug. 1985 (Draft).

Table C-6 Scope of Recycling and Treatment Facilities by State

States	Solvent recovery		Resource recovery		Mobile treatment		PCB services		Thermal treatment	
	Facilities serving each State	Facilities located in each State	Facilities serving each State	Facilities located in each State	Facilities serving each State	Facilities located in each State	Facilities serving each State	Facilities located in each State	Facilities serving each State	Facilities located in each State
Alabama	20	3	10	1	13	-	26	1	5	1
Alaska	-	-	-	-	-	-	1	-	-	-
Arizona	10	3	7	-	12	-	16	2	4	1
Arkansas	8	3	8	-	12	1	24	1	4	-
California	17	20	7	9	12	6	16	12	6	4
Colorado	5	4	6	-	12	-	18	2	4	-
Connecticut	18	2	12	1	12	-	26	1	11	0
Delaware	9	1	13	1	12	-	26	1	11	-
D.C.	3	-	7	-	10	-	22	1	3	-
Florida	10	4	13	1	14	3	24	1	9	1
Georgia	14	3	14	2	13	2	25	2	10	1
Idaho	7	-	6	-	12	1	18	2	4	1
Illinois	18	15	9	5	12	1	23	3	5	4
Indiana	12	2	13	1	12	-	23	4	11	1
Iowa	9	1	9	-	12	-	20	-	5	-
Kansas	9	1	7	4	12	2	21	4	5	1
Kentucky	12	1	14	1	12	-	27	2	12	2
Louisiana	13	-	8	-	12	1	25	-	5	1
Maine	18	-	12	-	12	-	25	-	9	-
Maryland	13	1	14	-	12	-	25	2	11	1
Massachusetts	12	3	7	-	12	-	25	2	6	2
Michigan	12	8	9	2	12	-	25	4	5	1

Table C-6 (continued)

States	Solvent recovery		Resource recovery		Mobile treatment		PCB services		Thermal treatment	
	Facilities serving each State	Facilities located in each State	Facilities serving each State	Facilities located in each State	Facilities serving each State	Facilities located in each State	Facilities serving each State	Facilities located in each State	Facilities serving each State	Facilities located in each State
Minnesota	8	2	10	1	12	-	26	3	5	2
Mississippi	10	1	7	-	13	-	24	-	4	-
Missouri	14	6	10	4	13	2	27	8	5	2
Montana	6	-	8	-	12	-	16	-	4	-
Nebraska	7	2	6	-	12	-	16	1	4	-
Nevada	6	-	7	-	12	-	14	1	4	-
New Hampshire	8	-	12	-	12	-	25	1	10	-
New Jersey	17	7	15	5	12	1	26	4	11	4
New Mexico	2	-	6	-	12	-	18	-	4	-
New York	20	6	15	3	12	-	31	5	12	1
North Carolina	19	3	14	4	13	1	25	3	12	2
North Dakota	2	-	6	-	12	-	17	-	4	-
Ohio	22	13	15	7	12	5	24	12	11	2
Oklahoma	8	2	6	-	12	-	19	-	4	-
Oregon	4	2	6	-	12	-	16	1	4	-
Pennsylvania	18	4	15	3	12	4	26	4	12	1
Rhode Island	10	1	12	-	12	-	25	-	10	-
South Carolina	13	3	13	3	13	-	25	-	11	3
South Dakota	3	-	7	-	12	-	18	-	4	-
Tennessee	13	2	12	1	12	2	26	4	12	1
Texas	12	6	6	7	12	4	18	6	4	3
Utah	3	-	6	-	12	-	16	-	4	-

Table C-6 (continued)

States	Solvent recovery		Resource recovery		Mobile treatment		PCB services		Thermal treatment	
	Facilities serving each State	Facilities located in each State	Facilities serving each State	Facilities located in each State	Facilities serving each State	Facilities located in each State	Facilities serving each State	Facilities located in each State	Facilities serving each State	Facilities located in each State
Vermont	9	-	12	-	12	-	24	-	10	-
Virginia	16	1	15	5	12	2	27	4	11	6
Washington	7	6	12	1	12	-	16	5	3	-
West Virginia	10	-	13	-	12	-	25	-	11	-
Wisconsin	6	6	7	-	12	-	19	4	5	1
Wyoming	3	-	7	-	12	-	15	-	4	-

Source: Environmental Information Ltd. 1984.

Table C-7 Types of Wastes Listed by Waste Exchanges

Wastes available	Wastes wanted
Solvents	
99% Methyl ethyl ketone, 1% laquer	Chlorinated and fluorinated hydrocarbons
Aromatic 140 solvent	Ketones
30-35% acetone, 65-70% water	Esters
45% solvent, 45% resin and pigment 10% wax	Alcohols
Orthodichlorobenzene	Aliphatics
94% trichlorethylene, 2% methanol, 2% acetone	Freon
Toluene diisocyanate residue	Aromatics
Spent halogenated and non-halogenated solvents	Various solvents, no more than 40% solids
	Pigments
	Halogenated solvents
	Flammable solvents, chlorinated solvents, and fluorinated solvents
Metals	
Zinc hydroxide filter cake	Alumina, aluminum, and aluminum sludge
Chrome drag-out solution	Nickel
Metal-plating sludge	Tungsten carbide
Electrodeless nickel bath	Copper solutions
Copper filter cake	Tin residue
Magnesium sludge	Precious metals
Aluminum oxide slag	Zirconia and zirconium compounds
60-70% Fe; 6% Cr; 3% Ni; 1% Si	Residues, grinding, spent catalysts, sludges, and waste byproducts containing nonferrous and precious metals
Zinc cyanide	
Zinc-containing dust from baghouses and scrubbers	
Corrosives	
Sodium hydroxide	Sodium hydroxide
Calcium	Aluminum chloride solution
Sodium nitrite	Sulfuric acid
Acetylene sludge	Alkali equal to 25,000 lbs/mo NaOH
Hydrochloric acid	Spent acids
Pickle liquors ($FeCl_2$, or $FeSO_4$)	Spent alkalis
Chromic acid	

Table C-7 (continued)

Wastes available	Wastes wanted
Halogenated Organics	
Unrinsed pesticide containers	No listings found
Cyanides/Reactives	
Sodium cyanide solution	No listings found
Cyanides; sodium, potassium, or metal cyanide	
Cyanide solution from cyanide recovery process	
Zinc cyanide	

Table C-8 Summary of Materials Recycled via Three Major Waste Exchanges

Type of wastes	Waste exchange	Time period	Quantity (tons)(f)	Distance transported (miles)	Estimated value ($)
Acids	IME[a]	1985	9.6	-	200 (d)
Acids					
Hydrochloric	NEIWE[b]	1983	18.3	25	23,790 (d)
Phosphoric	NEIWE	1983	208.0	100	645 (d)
Polyphosphoric	NEIWE	1983	18.3	850	80
Sulfuric	NEIWE	1983	750.0	15	40,000
Spent sulfuric acid	NEIWE	6/81 - 12/81	27	50	1,647
Isophthalic acid 220	NEIWE	6/81 - 12/81	11	-	990
Acetic anhydride	NEIWE	6/81 - 12/81	31	-	3,230
Polyphosphoric	NEIWE	2/82 - 2/83	50	600	15,000
Cupric chloride	NEIWE	2/82 - 2/83	33	600	3,600
Ferric chloride	NEIWE	2/82 - 2/83	675	125	18,000
Various acids	NEIWE	2/82 - 2/83	Unknown	Unknown	15,000
Alkalis	IME	1985	25.2	-	12,782 (d)
Liquid caustic soda	NEIWE	1983	2.1	25	50
Sodium nitrite solution	NEIWE	1983	100.0	975	2,000
20% sodium sulfide	NEIWE	2/82 - 2/83	480	275	35,000
Sodium sulfide	NEIWE	2/82 - 2/83	24	Unknown	12,000
Other inorganic chemicals	IME	1985	28.8	-	11,515 (d)
Inorganic chemicals	NEIWE	1983			
Chloroform	NEIWE	1983	1.6	20	3,000
Other inorganic chemicals	NEIWE	6/81 - 12/81			
Copper sulfate crystals			3	300	840
Potassium cyanide (e)			.11	125	150
Liquid bleach			2,167	25	52,000

Table C-8 (continued)

Type of wastes	Waste exchange	Time period	Quantity (tons)(f)	Distance transported (miles)	Estimated value ($)
Solvents	IME	1985	639.3	-	937,960 15,077 (d)
Organics/solvents	NEIWE	1983			
Carbon tetrachloride	NEIWE	1983	.9	400	396 (d)
Ethanol	NEIWE	1983	3.8	450	400
Lacquer solvent	NEIWE	1983	Unknown	200	875
Mixed solvents	NEIWE	1983	75.0	200	16,000
Paint & ink wash solvents	NEIWE	1983	8.3	50	2,000
Paint solvents	NEIWE	1983	27.5	175	20,000
Phenol	NEIWE	1983	.3	5	250
Polydimethylsiloxane	NEIWE	1983	2.7	175	3,000
Trichloroethane	NEIWE	1983	3.4	375	1,500
Trichloroethylene	NEIWE	1983	4.2	60	2,000
Acetone (e)	NEIWE	6/81 - 12/81	.6	75	208
Solvents (e)	NEIWE	6/81 - 12/81	10	125	2,040
Trichloroethylene (e)	NEIWE	6/81 - 12/81	3	75	None
Trichloroethane (e)	NEIWE	6/81 - 12/81	3	25	1,100
Solvents	NEIWE	6/81 - 12/81	55	250	10,000
Ethylene glycol	NEIWE	6/81 - 12/81	5	75	3,000
Solvents	NEIWE	6/81 - 12/81	142	150	39,000
Mixed ethylene glycols	NEIWE	6/81 - 12/81	16	Unknown	Unknown
Trichloroethane	NEIWE	6/81 - 12/81	3	Unknown	2,992
Paint thinner	NEIWE	2/82 - 2/83	42	175	14,000
Trichloroethane	NEIWE	2/82 - 2/83	2	75	385
Alcohols	NEIWE	2/82 - 2/83	Unknown	Unknown	Unknown
Solvents	NEIWE	2/82 - 2/83	210	Unknown	110,000
Chemicals	PWE	1983 - 1984	2476	-	482,200 (g) 583,489 (h)

Table C-8 (continued)

Type of wastes	Waste exchange	Time period	Quantity (tons)(f)	Distance hauled (miles)	Estimated value ($)
Other organic chemicals	IME	1985	.9	-	1,290 (d)
Metals and metal sludges	IME	1985	56.9	-	24,000 1,000 (d)
Metals	PWE[c]	1983 - 1984	6.9	-	15,000 (g) 18,602 (h)
Metal/metal solutions	NEIWE	1983			
Copper oxide	NEIWE	1983	10.0	1,025	5,000
Copper oxide	NEIWE	1983	5.0	25	2,400
Copper sulfate	NEIWE	1983	41.7	50	37,905 (d)
Nickel sludge	NEIWE	1983	80.0	200	5,000
Metal/metal sludges					
Copper sulfate solution (e)	NEIWE	6/81 - 12/81	7	400	1,000
Metal/metal sludges					
Copper sulfate solution	NEIWE	2/82 - 2/83	Unknown	150	400

[a] IME = Industrial Material Exchange.
[b] NEIWE = Northeast Industrial Waste Exchange.
[c] PWE = Piedmont Waste Exchange.
[d] Unit cost estimate obtained from Chemical Marketing Reporter, May 28, 1984 issue.
[e] One-time only transaction.
[f] Formula used was 250 gal/ton.
[g] Savings/earnings.
[h] Average Replacement Value (Aggregate).

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APPENDIX D

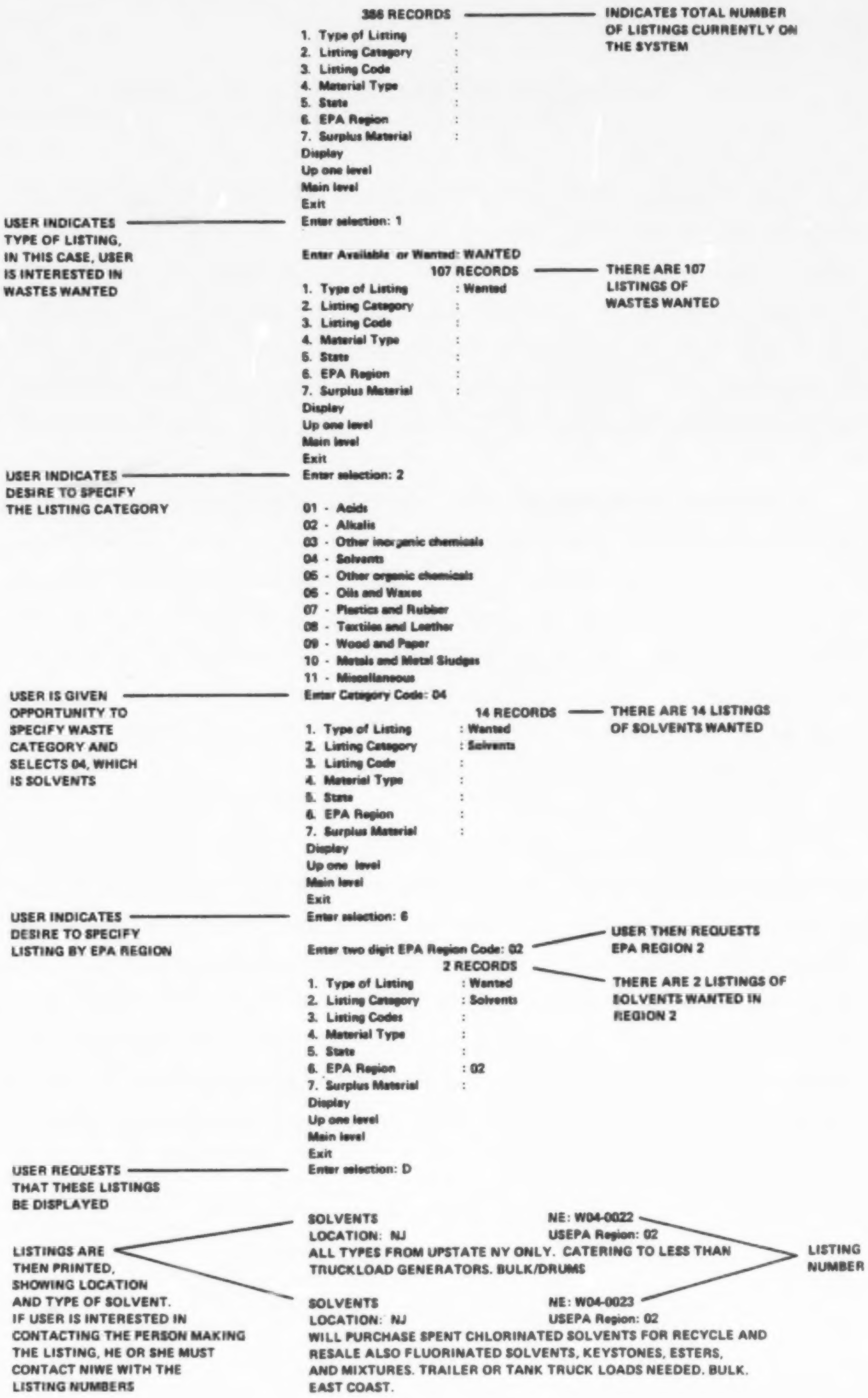
NORTHEAST INDUSTRIAL WASTE EXCHANGE'S ON-LINE COMPUTER SYSTEM

NORTHEAST INDUSTRIAL WASTE EXCHANGE'S ON-LINE COMPUTER SYSTEM

The Northeast Industrial Waste Exchange (NIWE) functions as a passive information clearinghouse. Established in 1981 by the Manufacturers Association of Central New York in cooperation with the Central New York Regional Planning and Development Board, the nonprofit exchange is co-sponsored and partially funded by the New York State Environmental Facilities Corporation and by the Ohio Environmental Protection Agency. The information is widely circulated but used primarily in New York, New Jersey, New England, Pennsylvania, Ohio, and Maryland.

Information is distributed in two ways; a Listings Catalog is published quarterly, and a computerized waste materials listings service is available. Each February, May, August, and November, a list of "Materials Available" and "Materials Wanted" is printed and distributed as widely as possible, with current circulation numbering 8,500. A company wishing to have information included in a list may do so for $25 for three issues. The information is also made available on the computerized listings for the same period of time (Northeast Industrial Waste Exchange, Listings Catalog, Issue No. 18., November 1985, p. 5).

The computerized service is provided free of charge and is available to anyone having access to a microcomputer and modem; the Exchange provides the necessary password. The service is designed to allow immediate access to current information. Figure D-1 provides an example of a search. In this case, the searcher is looking for a company in New Jersey or New York (EPA Region 2) that wants recyclable solvents. The inquirer would then notify the exchange of interest in either of the matches found. The companies listed would then be notified so that the two parties could negotiate an exchange (personal communication with Lewis Cutler, NIW, December 18, 1985).



```
              386 RECORDS
1.  Type of Listing        :
2.  Listing Category       :
3.  Listing Code           :
4.  Material Type          :
5.  State                  :
6.  EPA Region             :
7.  Surplus Material       :
Display
Up one level
Main level
Exit
Enter selection: 1
```

INDICATES TOTAL NUMBER OF LISTINGS CURRENTLY ON THE SYSTEM

USER INDICATES TYPE OF LISTING, IN THIS CASE, USER IS INTERESTED IN WASTES WANTED

```
Enter Available or Wanted: WANTED
                       107 RECORDS
1.  Type of Listing        : Wanted
2.  Listing Category       :
3.  Listing Code           :
4.  Material Type          :
5.  State                  :
6.  EPA Region             :
7.  Surplus Material       :
Display
Up one level
Main level
Exit
Enter selection: 2
```

THERE ARE 107 LISTINGS OF WASTES WANTED

USER INDICATES DESIRE TO SPECIFY THE LISTING CATEGORY

```
01 - Acids
02 - Alkalis
03 - Other inorganic chemicals
04 - Solvents
05 - Other organic chemicals
06 - Oils and Waxes
07 - Plastics and Rubber
08 - Textiles and Leather
09 - Wood and Paper
10 - Metals and Metal Sludges
11 - Miscellaneous
Enter Category Code: 04
                        14 RECORDS
1.  Type of Listing        : Wanted
2.  Listing Category       : Solvents
3.  Listing Code           :
4.  Material Type          :
5.  State                  :
6.  EPA Region             :
7.  Surplus Material       :
Display
Up one level
Main level
Exit
Enter selection: 6
```

USER IS GIVEN OPPORTUNITY TO SPECIFY WASTE CATEGORY AND SELECTS 04, WHICH IS SOLVENTS

THERE ARE 14 LISTINGS OF SOLVENTS WANTED

USER INDICATES DESIRE TO SPECIFY LISTING BY EPA REGION

```
Enter two digit EPA Region Code: 02
                        2 RECORDS
1.  Type of Listing        : Wanted
2.  Listing Category       : Solvents
3.  Listing Codes          :
4.  Material Type          :
5.  State                  :
6.  EPA Region             : 02
7.  Surplus Material       :
Display
Up one level
Main level
Exit
Enter selection: D
```

USER THEN REQUESTS EPA REGION 2

THERE ARE 2 LISTINGS OF SOLVENTS WANTED IN REGION 2

USER REQUESTS THAT THESE LISTINGS BE DISPLAYED

```
SOLVENTS                          NE: W04-0022
LOCATION:  NJ                     USEPA Region: 02
ALL TYPES FROM UPSTATE NY ONLY.  CATERING TO LESS THAN
TRUCKLOAD GENERATORS. BULK/DRUMS

SOLVENTS                          NE: W04-0023
LOCATION:  NJ                     USEPA Region: 02
WILL PURCHASE SPENT CHLORINATED SOLVENTS FOR RECYCLE AND
RESALE ALSO FLUORINATED SOLVENTS, KEYSTONES, ESTERS,
AND MIXTURES. TRAILER OR TANK TRUCK LOADS NEEDED. BULK.
EAST COAST.
```

LISTINGS ARE THEN PRINTED, SHOWING LOCATION AND TYPE OF SOLVENT. IF USER IS INTERESTED IN CONTACTING THE PERSON MAKING THE LISTING, HE OR SHE MUST CONTACT NIWE WITH THE LISTING NUMBERS

LISTING NUMBER

Figure D-1 Sample Output from NIWE Computer Search

APPENDIX E

CONDUCTING A PROJECT PROFITABILITY ANALYSIS

CONDUCTING A PROJECT PROFITABILITY ANALYSIS

This appendix provides information on how a profitability analysis is conducted to evaluate investments in waste minimization technology and methods. The crucial question in making an investment in waste minimization is "How much will it return to the firm?" To answer this question, a method for evaluating the profitability of the investment and comparing it to other investment opportunities is required.

The simplest method to use is the payback period. The payback period is defined as the minimum length of time required to recover the modification cost in the firm of cash flows to the project, based on total income minus all costs except depreciation. The formula for quickly estimating the payback period (PBP) is:

$$\text{PBP} = \frac{\text{depreciable capital investment}}{\text{avg. annual profit + avg. annual depreciation}}$$

For a waste reduction project, the denominator in the formula would consist of average annual cost savings plus average annual depreciation. For example, suppose a waste generator installs a piece of equipment that generates $100,000 per year in cost savings and depreciation. If the total cost of the equipment was $300,000, then the payback period is three years. This formula is reliable only for projects that return consistent amounts from year to year. For projects with a high variation in annual returns, it is necessary to calculate the cumulative total each year, and check it against the depreciable capital investment. Payback periods in the range of three to four years are considered acceptable for low risk investments.

The payback period is a measure of an investment's liquidity (i.e., how fast the cost is recovered). A short payback period is thus a desirable characteristic. Selecting a waste reduction project over another investment solely on the basis of its short payback period may not be wise because another alternative with a longer payback period may offer a higher return on investment over its assumed economic life. The payback period does not measure the profitability of the investment, nor does it account for the time value of money or for inflation. For these reasons, many corporations use discounted cash flow methods that take these factors into account.

The discounted cash flow (DCF) method has two main variants. One of these variants is the net present value (NPV) method, which recognizes the time value of money by discounting projected net cash flows to the present. The NPV method is shown by the formula:

$$NPV = \sum_{i=0}^{n} \frac{(PTCF)_i}{(1+r)^i}$$

where

PTCF = the post tax cash flow
r = the average cost of the capital
n = the assumed life of the project

If the net present value of a project is higher than zero, then the investment is earning more than the cost of capital and the firm can increase its wealth by undertaking the project. The other variant of the DCF method is the internal rate of return (IRR) method, in which a discount rate is found such that the sum of the present values of future net cash flows, including the initial cost of the investment, is equal to zero. If this rate, called the internal rate of return, is higher than the firm's average cost of capital (which is the minimum required rate of return) then the project is profitable. Typically, the initial cost of implementing a waste reduction program outweighs the short-term savings in the total cost of hazardous waste generation. However, by using the DCF method, one can compare the cumulative effect of the program on the facility's cash flow to the total cost of the investment. For investments with a low level of risk, a post tax internal rate of return in the 12 to 15 percent range is frequently acceptable.

The first step in evaluating a waste reduction project is to estimate the future cash flows the investment will generate. Investments in waste reduction can differ from other investments in at least two important respects. First, waste reduction is often an investment not to generate revenue but to reduce future costs (e.g., cleanup, liability insurance, and disposal costs). These cost savings will be reflected in the project's cash flows. Second, a waste reduction project may offer the possibility of using an accelerated depreciation schedule, in which case a tax savings will be realized, which in turn will increase the project's net cash flow.

The main difficulty in estimating project cash flows is that these cash flows occur in the future, and thus forecasting of future production volumes, tax requirements, and other related factors becomes necessary. Once the estimates are made, they should be organized for the analysis. Summary forms can be used to classify the estimates by category and year. An investment summary form contains information on fixed and working capital requirements. A sample investment summary form appears in Figure E-1. A depreciation summary form should show depreciation amounts relating to each piece or category of equipment (especially if they are depreciated at different rates) and yearly depreciation amounts. Tax credits for equipment purchases and writeoffs should also be included. This makes annual tax savings in the form of depreciation, tax credits, and write-offs readily available.

A summary form can also be constructed for gross savings from the investment. A sample gross savings summary form appears in Figure E-2. Cost impacts should be investigated for the cost categories outlined in Section 5.1.3. Not all of the costs listed are easily estimated. For example, future cleanup costs (see Section 5.2.2) are uncertain, as are the costs of pollution liability insurance, emergency preparedness, and State fees and taxes. Estimation of many cost savings will involve making assumptions about future regulatory requirements. The trend has been for these requirements to become more stringent and for waste generation costs to rise. A conservative estimate of cost savings from the project is obtained if it is assumed that the firm would incur the present waste generation costs over the period of time that corresponds to the life of the investment.

OUTLAYS	ANNUAL PERIOD				
	1	2	3	4	5
Land					
Buildings					
Equipment					
(1) Total capital					
Project supplies					
Spare parts					
Other					
(2) Total expenses					
Cash					
Accounts receivable					
Inventories					
(3) Subtotal current assets					
Accounts payable					
Income taxes payable					
(4) Subtotal current liabilities					
(5) Working capital [(3) - (4)]					
TOTAL OUTLAYS [(1) + (2) + (5)]					

Figure E-1 Investment Summary

AVOIDED COSTS	ANNUAL PERIOD									
	1	2	3	4	5	6	7	8	9	10...n
Disposal fees										
Generator fees/taxes										
Transport										
Storage and handling										
Compliance equipment and pre-disposal treatment										
Permit costs										
Reporting costs										
Manifesting costs										
Emergency preparation and cleanup										
Pollution liability insurance										
Raw material purchases										
GROSS SAVINGS										

Figure E-2 Gross Savings Calculation Form

Finally, it is not unusual to vary the financial performance requirements (e.g., internal rate of return) of an investment with respect to an identified but unquantified level of risk. In this manner, it may be appropriate to decrease the financial performance requirements imposed on investments in waste minimization. Such adjustments would reflect the potential benefits associated with investments in waste minimization, in terms of avoided future costs (e.g., cleanup waste transport and disposal, and pollution liability insurance) which were not quantified and did not enter the analysis directly. For example, the acceptable payback period may be increased to five years instead of the more conventional three to four years to account for the non-inclusion of the hard-to-estimate avoided future costs. Alternatively, the acceptable internal rate of return may be lowered for the same reason (i.e., unquantified future cost savings).

Once the depreciation and cost savings have been calculated, a cash flow summary can be prepared. A sample cash flow summary form appears in Figure E-3. From gross savings, additional operation costs attributable to the project, such as extra manhour and energy requirements, are subtracted as are other cash expenses. These other cash expenses include project start-up costs, construction start-up, and the cost of off-spec product turned out during project operation. Annual depreciation and tax credits from the depreciation summary form are then subtracted to give net profit before taxes.

Cash flow estimates used in investment profitability analysis are generally presented after taxes. Applying the appropriate tax rate to net profit gives net profit after taxes. Adding back depreciation and tax credits gives the annual post-tax cash flow. These cash flows are used to calculate payback period, net present value, and internal rate of return for the investment.

A discounted cash flow calculation form appears in Figure E-4. Here, time "0" is the start of the construction period. Discounted cash flow methods require choosing a reference point in time at which the value of the return generated by the

CASH FLOW SUMMARY	ANNUAL PERIOD									
	1	2	3	4	5	6	7	8	9	10...n
Annual production quantity										
Net receipts or gross savings										
Less: cash operating costs										
Less: other cash expenses										
Less: depreciation, tax credits and write-offs										
Net profit before taxes										
Less: income taxes at ____%										
Net profit after taxes										
Add back: depreciation, tax credits, etc.										
POST-TAX CASH FLOW										

Figure.E-3 Cash Flow Summary

CASH FLOW SUMMARY	ANNUAL PERIOD									
	1	2	3	4	5	6	7	8	9	10...n
Annual production quantity										
Net receipts or gross savings										
Less: cash operating costs										
Less: other cash expenses										
Less: depreciation, tax credits and write-offs										
Net profit before taxes										
Less: income taxes at ____%										
Net profit after taxes										
Add back: depreciation, tax credits, etc.										
POST-TAX CASH FLOW										

Figure.E-3 Cash Flow Summary

		ANNUAL PERIOD									
		1	2	3	4	5	6	7	8	9	10...n
CASH FLOWS	Investment summary										
	Cash flow summary										
	Net of all cash flows										
TRIAL 1 ____ % discount rate	Discount factor										
	Present value										
TRIAL 2 ____ % discount rate	Discount factor										
	Present value										
. . .											
TRIAL 1 ____ % discount rate	Discount factor										
	Present value										

Figure E-4 Discounted Cash Flow Summary

investment will be measured. The important thing to remember is that cash amounts spent or received before time "O" must be escalated (or compounded), and cash amounts spent or received after time "O" must be discounted to reflect their proper value at that point in time.

Using the amounts from the investment and cash flow summaries, net cash flows (post-tax cash flow minus investment) can be entered for each year. To calculate the net present value of the project, the net cash flows are reduced by discount factors corresponding to the firm's average cost of capital. The sum of the discounted cash flows is the net present value of the project. As stated above, a positive net present value means that the project will increase the wealth of the firm.

Calculating the internal rate of return (IRR) is more difficult. The unknown to be solved for is the discount rate that makes the sum of the discounted net cash flows, including the initial cost of the investment, equal to zero. Finding the proper discount rate is an iterative process. If a rate produces a sum higher than zero, then a higher rate must be tried. A number of financial analysis software programs contain algorithms that greatly simplify this calculation.

Investment projects analyzed using discounted cash flow methods can be compared only if the reference point -- time "O" -- is the same for all projects. For ranking projects, the internal rate of return method is preferred by some companies because it provides comparable indices, whereas the net present value method gives cash amounts resulting from different investment commitments. However, the net present value method can be modified slightly to give a benefit-to-cost ratio (i.e., the dollar return per dollar invested). Calculating this ratio for all investment opportunities also yields a set of indices by which projects can be ranked. In addition, the NPV method allows returns to be summed over a group of investments because returns are given in current dollar amounts. This is amenable to the capital budgeting process, where the firm is trying to maximize the profits obtainable from a fixed pool of funds.

Other measures can be employed to assess the impacts of investment projects on firms. For example, contribution analysis can be used to rapidly determine the effects of changes in manufacturing costs on profitability. These methods are not substitutes for DCF methods. The objective is always to maximize the present value of the cash flow that can be generated by the available pool of capital.

APPENDIX F

EPA'S DEFINITION OF SOLID WASTE

EPA'S DEFINITION OF SOLID WASTE

EPA published a revised version of the definition of solid waste in the January 4, 1985, Federal Register. The revised definition introduces new tests by which a substance may be deemed a solid waste and legitimately recycled. In essence, this revision defines RCRA jurisdiction over materials being recycled to be determined by what the material is and how it is being recycled.

The definition itself is complicated; as an aid to understanding it, the flow chart (Figure F-1) provides an overview of the entire definition, with appropriate references to the position of the regulation. The central concept in this definition of solid waste is that of throwing something away. If a material is thrown away, it is a solid waste; if it is not thrown away, it is not a solid waste. The definition expands the concept of throwing away to include (1) storing or treating the material if the storing or treating occurs prior to its being thrown away, or (2) certain types of recycling activities. In the former case, storing or treating the material prior to recycling may meet the specified specifications for solid waste, while in the latter case, qualification as a solid waste is dependent upon what the material is and how it is to be recycled. Thus, certain types of recycling activities may be deemed throwing away.

Another important aspect of the definition is that although a material may qualify as a solid waste, any activity associated with it is not automatically subject to RCRA regulation. A solid waste material would be regulated only if (1) the material is a hazardous waste and (2) the activity involving the material is subject to the RCRA hazardous waste management standards. For example, although some of the various wastes recycled onsite may qualify as solid wastes under the definition, the actual recycling activity is not regulated under RCRA. If the waste is stored onsite for more than 90 days prior to recycling, or if it is stored for any length of time in a surface impoundment or waste pile prior to recycling onsite, then RCRA regulations would apply to the storage of such waste. In such instances, the recycling activity would still not be regulated. For wastes that are recycled by shipping offsite, and which qualify as solid wastes under the definition, the manifesting requirements of the RCRA regulations would apply. Similarly, if the recycling facility stores the wastes as described above, the appropriate RCRA regulations would apply. There are, however, no current waste management standards that apply to the recycling practices themselves (40 CFR 261.6 and 266 Subpart C).

Below are brief descriptions of the four major activity areas delineated in the definition of solid wastes, followed by a discussion of the incentives and constraints to recycling that the new definition may pose.

I. Major Activity Areas Included in the Definition

The definition states that four types of recycling activities are within EPA's jurisdiction:

1. Use constituting disposal;
2. Burning waste or waste fuels for energy recovery or using wastes to produce a fuel;
3. Reclamation; and
4. Speculative accumulation.

These four categories of recycling activities are further divided according to the type of material involved: spent materials, sludges (listed or characteristic), byproducts (listed or characteristic), commercial chemical products, or scrap metal. Table 5-5 of Volume 1 provides a summary of which materials are defined as solid wastes when handled in the respective activity areas.

A. Use Constituting Disposal

With the exception of commercial chemical products for which land application is the normal, intended use, all waste materials that are hazardous are defined as solid wastes when placed on or in the land. An example of a land-applied waste material that would not be defined as a solid waste is rinsate from pesticide containers. The rinsate is essentially the same product, and is being applied to the land in the manner intended for the original product.

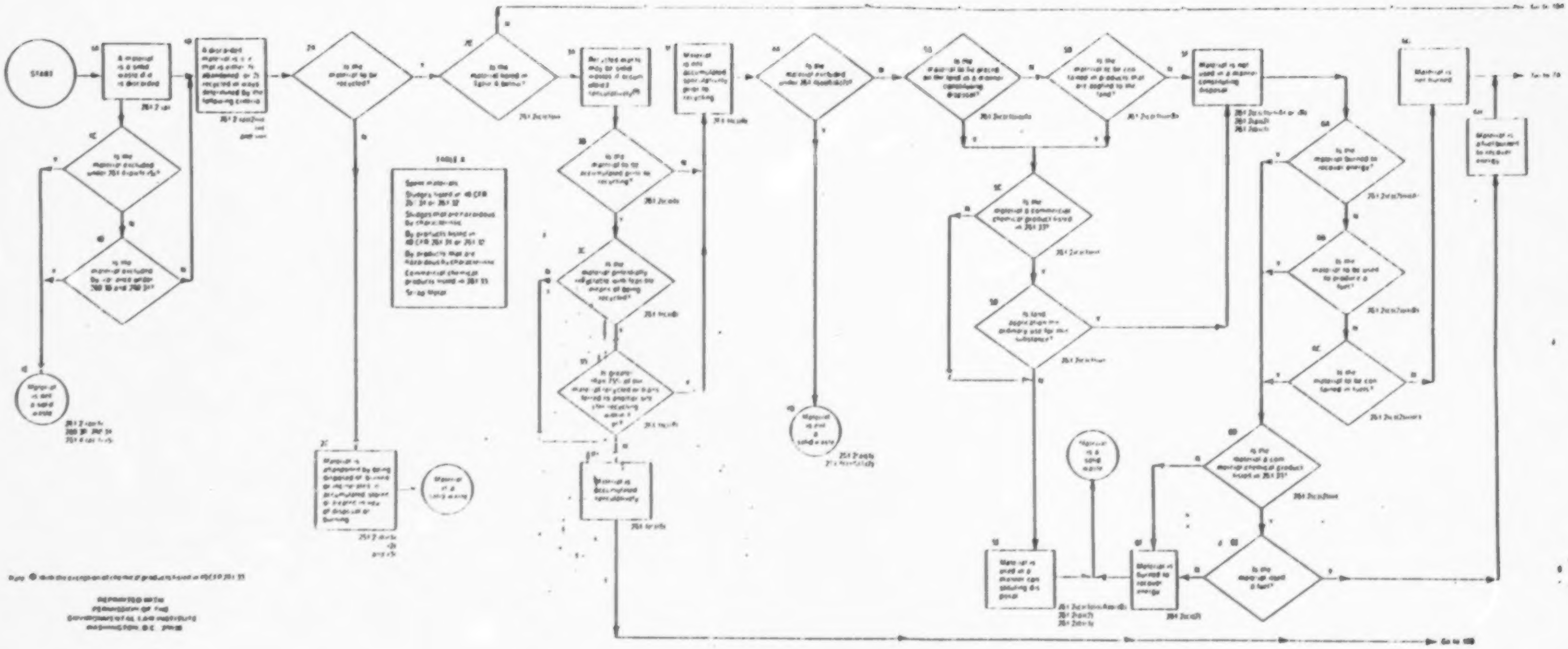
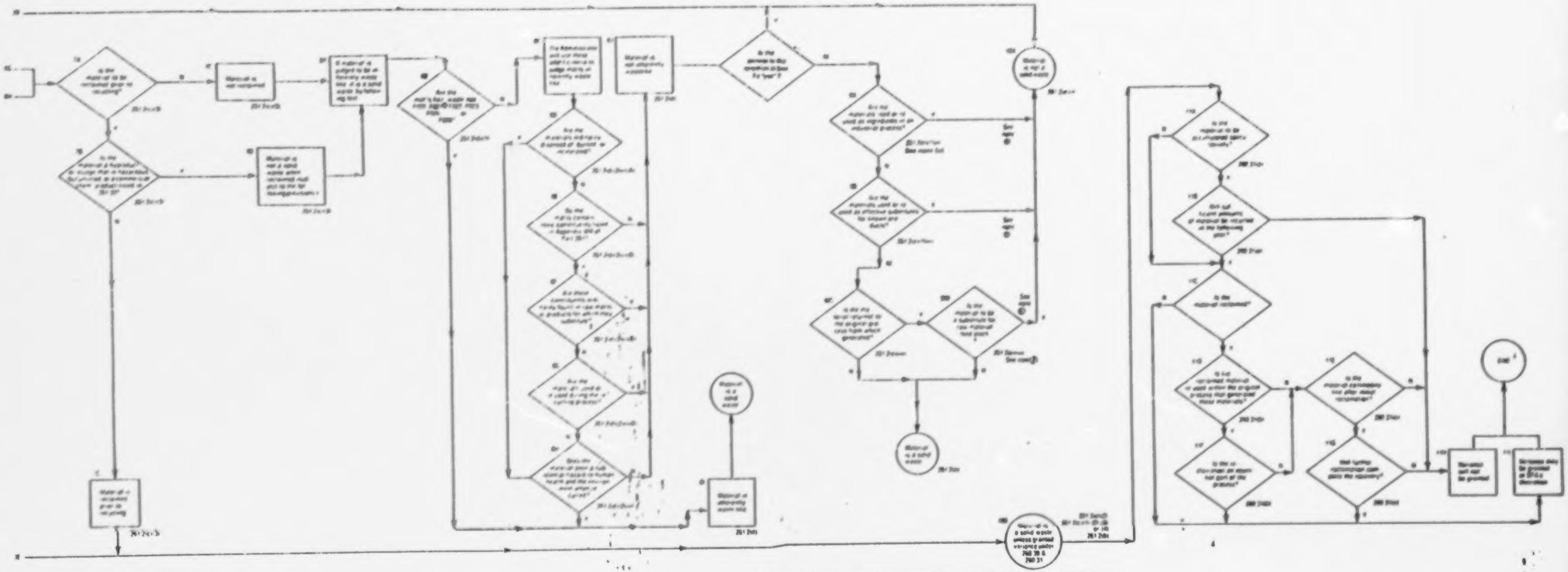


Figure F-1. Flow Chart of EPA's Definition of Solid Waste



261.2(c)(5)
261.2(b)
261.2(d)
Material is a solid waste unless granted variance under 260.30 & 260.31

Note ① Not included if used as an ingredient to make a product at the site of generation.

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Notes ① Materials may still be solid wastes if used or reused, or returned to original process and 1) disposed or used to produce products applied to the land; 2) burned for energy recovery or used to produce or contained in fuels; 3) accumulated speculatively; or 4) are inherently waste-like.
② The process itself must use raw materials as principal feedstocks.
③ Exclusions from the definition are granted only if materials are not reclaimed. An exemption to this may be granted if the material is returned to the original process from which generated. See boxes 9C and 9D.

Figure F-1. Flow Chart of EPA's Definition of Solid Waste (Concluded)

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As another example, assume that a waste stream is mixed with oil and placed on the land. If the waste material is a listed or characteristic hazardous waste, it qualifies as a solid waste under the definition. Because of this classification, the placement of this material on the land would now be subject to RCRA regulation.

Not all hazardous waste-derived products are subject to regulation, however; their classification as solid wastes does not imply that they are fully regulated. If the waste is used to make commercial fertilizer, the application of the fertilizer to the land is not presently regulated. There are important issues associated with this example, however, and they are discussed below in further detail.

B. Burning for Energy Recovery

With the exception of waste materials that are commercial chemical products intended for burning or using as an ingredient in a fuel, hazardous wastes burned for energy recovery are solid wastes. Although they are considered solid wastes, the actual burning of the materials is not yet regulated. Eventually there will be limits imposed on the contaminants for the materials burned in boilers and other energy recovery devices; a rule to this effect was published in the November 29, 1985, Federal Register.

Another distinction made by EPA is between burning for material recovery and burning for energy recovery. If a material is burned as part of a material recovery process, it would not be considered to be burned as a fuel, provided that the burning is an integral part of the normal recovery process. If burning is not a normal part of the operation, EPA will consider the materials to be burned as a fuel and will regulate such burning accordingly. Also, when both materials and energy are recovered from burning waste materials, EPA will consider it to be burned as a fuel.

C. Reclamation

The reclamation of a waste refers to the processing or regeneration of that waste to enable the recovery of a usable product. Materials defined as hazardous wastes that are reclaimed prior to being recycled are solid wastes, except for

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byproducts and sludges that are hazardous by characteristic, and commercial chemical products. The definition allows for variances to be made for those situations in which a minimal amount of processing is needed to complete recovery.

D. Speculative Accumulation

As discussed earlier, storage of a material prior to recycling may be under RCRA jurisdiction, depending on what the material is and how it is to be recycled. For those instances in which the material being recycled is otherwise excluded from the definition of solid waste, it may still qualify if less than 75 percent of the material is recycled or transferred to another facility within one year. (This condition does not apply to waste materials that are chemical products.)

A variance from this provision of the definition is allowed if the petitioner can demonstrate that economic and/or other conditions prevented his or her company from recycling the required 75 percent.

II. Materials That Are Not Solid Wastes When Recycled

Wastes that are recycled by direct use are usually not defined as solid wastes if reclamation of the material does not occur prior to, or as a condition of, its being used. Three situations are specified in the definition in which the direct use of the waste would exclude it from the solid waste definition:

- The material is used as an ingredient in an industrial process to make a product;
- It is used as an effective substitute for commercial products; or
- The material is returned to the process from which it was generated, to be used as a substitute for raw material feedstocks.

For each of the above situations, reclamation must not occur prior to or during the material's use. Also, if a waste material fails to be excluded from the solid waste definition for one of the three criteria, it could still be excluded if it qualifies under the other two. For example, the third condition specifies that a waste material must be returned as a substitute for raw material feedstocks to the process from which it originated. A waste solvent used for degreasing, returned to the same degreasing operation, would not qualify under the third situation, since it is not being returned to a production process. It would, however, qualify for exclusion under the second situation, because it is being used as an effective substitute for a commercial product and it is not being reclaimed prior to being reused. If it were spent solvent that must be distilled prior to being reused, it would not be excluded, since the distillation qualifies as reclamation prior to its reuse. In this case, since it is not excluded, generators would be required to manifest the waste if it were shipped offsite. If the material were to be stored onsite for more than 90 days, a TSDF permit would be required.

The end use of the product in which the waste is incorporated is of extreme importance in considering whether a material is excluded. For example, use of a waste material to make fertilizer would define the material as a solid waste (unless the waste material were a commercial chemical product for which fertilizer manufacture is an intended use). Since it is incorporated in a product that would be applied to the land, this would be considered use constituting disposal and would be a solid waste. Although waste-derived commercial fertilizers are not as yet regulated, this is still an important consideration for reasons to be discussed below.

III. Incentives and Constraints of the Definition

The definition presents some problems for companies that may wish to recycle. Some of the problems lie in the companies' misinterpretation of the regulation, in increased requirements resulting from the definition, and in confusing issues that may result in disputes with EPA.

A. Effect on Generators

Waste that is defined to be a "solid waste" under the definition is both a hazardous and solid waste and thus subject to RCRA management standards. As a result, generators will have to report the quantities of such waste under the reporting requirements of Section 3310 of RCRA, even if the waste is recycled onsite and is not stored for more than 90 days. The notification must state the location, general description of such activities, and the identified or listed hazardous waste that the generator handles.

In addition, the definition will result in generators now having to manifest some wastes shipped offsite that, under the previous set of regulations, were exempt from such requirements. For example, a spent material (e.g., a spent solvent) is defined as a solid waste if it is both a hazardous waste and is reclaimed prior to being recycled. If the generator were to ship the spent material offsite to be reclaimed, a manifest would be required.

The manifest, in effect, places the generator's name on the waste - a factor that may cause reluctance to ship wastes offsite to be recycled because of future liability. Future liability is of concern to most generators since, under the strict, joint, and several liability provisions of the Superfund law (CERCLA) they may be liable for the costs of cleanups of leaks or spills that involve their wastes. To generators who previously did not have to manifest wastes when shipping to reclaimers, this is a constraint to recycling, since it is not clear to what extent they may be liable for any future accident or leak.

One advantage of this situation, however, is that the generator has an increased need to know the reliability of the recycler to which the waste is shipped. Thus, the definition may achieve a decrease in the number of "sham" recycling operations if generators take extra care in finding out more about the company doing the recycling. Smaller companies, however, may not be able to assess the adequacy or reliability of recyclers. Larger companies such as IBM, for example, conduct audits of the companies to which they send wastes for recycling. A small company may not have the expertise available to make such an assessment.

In addition to these concerns, the issues of final product end use and what constitutes reclaiming also may play a role in affecting a company's decision on whether or not to recycle. These issues have particular relevance for specific applications, as discussed below.

1. Hazardous waste-derived fertilizers. A material that is a hazardous waste and is used as an ingredient in making fertilizers is a solid waste (unless the waste is a commercial chemical product for which the normal intended use is land application). Because the final product is applied to the land, the hazardous materials incorporated in it are defined as solid wastes. Even though they are defined as solid wastes, however, hazardous waste-derived fertilizers are not currently regulated provided the fertilizer is used commercially.

"Commercially" (as it is discussed in the preamble of the January 4, 1985, Federal Register) has a specific meaning and refers to materials that are sold to the general public. If the generator uses the material himself, it is not considered commercial use and a RCRA permit would be required for application of the material on the land. Discussions with EPA personnel (personal communication with Matt Straus, U.S. EPA, July 26, 1985) indicate that the reason for this distinction is the utility of its implementation. Eventually, EPA will be examining the degree to which all fertilizers should be regulated. At this time, however, EPA feels that it is not feasible to require that all applicators of fertilizers obtain RCRA permits. The result of this EPA policy is that only the noncommercial use of hazardous waste-derived fertilizers will be regulated.

This aspect of the definition and its interpretation has the potential to result in a constraint to companies with the ability to recycle material for use as ingredients in fertilizer. How this works as a constraint is shown in the following example provided by EPA (personal communication with Matt Straus, U.S. EPA, July 26, 1985). A company generates K061 dust which it sells to a fertilizer manufacturing company. The company adds lime, briquettes it, and sells it to the public. Under the new definition, this is commercial use and is therefore not regulated. The company shipping the wastes, however, must manifest them since they are defined as solid wastes. The company then decides it wants to perform the same operation in-house that the fertilizer company had performed, namely, adding lime and briquetting. The company requests that EPA clarify whether application of the resulting fertilizer product would be regulated.

In this case, EPA decided that for the generators to perform the same step in-house and sell the processed material to an intermediary does not qualify as commercial use. Presumably, distributing directly to the consumer, rather than through a manufacturer or wholesaler, legitimates its commerciality. Consequently, a permit would be required for application of the material to the land if the material were manufactured in-house and not sold directly to the public.

In the above instance, the company initially decided it would be to its benefit to process the waste material in-house since, under the new definition, shipping offsite would require manifesting the material now defined as a solid waste. The company in the example may have seen the possibility of not having to manifest the waste by processing it onsite, as well as of achieving a return on its investment by marketing the material itself. EPA's decision in the matter now leaves the company with the alternative of continuing to ship offsite and manifesting it, or finding a less risky means of disposal with respect to future liability. Onsite incineration may be a possibility if (1) the company has a permitted incinerator and (2) the incinerator has the capacity to handle this waste. As discussed in the section on permitting, obtaining an incinerator permit is time consuming and would not be an attractive option.

Another aspect of the waste-derived fertilizer situation is shown by the following example (personal communication with Matt Straus, U.S. EPA, July 26, 1985): A sludge is reclaimed at a recycling facility to recover zinc. The recycler ships the zinc to a fertilizer company for use in the manufacture of fertilizer. Since the fertilizer is applied to the land, the use of zinc as an ingredient in the fertilizer renders the zinc a solid waste. The zinc must therefore be manifested when shipped to the fertilizer company. If the zinc were shipped to a paint manufacturing company, however, it would not be a solid waste, since paints are usually not products applied to the land.

The example illustrates how the same material (zinc) may be deemed a waste in one instance and a product in another. Similarly, in the first example, the same product may be regulated in one instance and not in another. From the standpoint of regulators, a decline in the amount of waste-derived products applied to the land can be seen as beneficial. However, the definition and regulatory scheme presently do not take into account the equivalency of the waste-derived product to the one derived from so-called virgin feedstocks. Companies may, therefore, view this as a disincentive to consider using their waste products for such purposes, and may instead consider alternatives that could present a potential for environmental damage, including the option of illegal disposal.

2. Materials used as ingredients in industrial processes. The definition makes a distinction between materials that are used directly in a process without reclamation beforehand and materials that must be reclaimed prior to being used. In addition, if the use of a material as an ingredient in a process results in the reclamation of that material, it is defined as a solid waste. Similarly, a material returned to the generating process that is "raw material based" is excluded from the definition, provided it is not reclaimed beforehand.

For materials that are recycled onsite, these provisions do not constrain such operations, even if reclamation is conducted prior to use. This is because the recycling process itself is not currently regulated. Materials shipped offsite, if solid wastes, are subject to manifesting requirements. Thus, this provision of the solid waste definition may serve as an incentive to use the waste materials directly in processes onsite or offsite without prior reclamation. EPA's concern for "sham" operations dictates in large part the condition that materials not be reclaimed prior to or during the industrial process to which they are introduced. The difficulty arises in determining what constitutes reclamation.

An example of a material used as an ingredient in an industrial process but considered to be "reclaimed" was presented by EPA (personal communication with Matt Straus, U.S. EPA, July 26, 1985): A company ships spent pickle liquor offsite; it is mixed with iron and chlorine and evaporated to obtain salable ferric chloride. Although the pickle liquor is mixed with other materials, and hence is an "ingredient," the mixing and subsequent evaporation would be considered reclamation, since pickle liquor normally contains ferric chloride that can be used directly. The purpose of the reclamation process is to remove the acidity. The mixing and evaporation is a reclamation step and not solely an ingredient mixing process. Thus, the company shipping the pickle liquor would have to manifest it.

From the standpoint of the regulators, the reclamation provision of the definition is necessary in order to prevent companies from labeling processes as "ingredient" steps in order to avoid regulation (i.e., shipping wastes unmanifested offsite for use as an ingredient in another process). There may be an incentive also in that companies may be encouraged to perform such operations onsite whenever possible. For companies that cannot accommodate such an onsite operation, this aspect of the regulation may present a constraint.

The condition that a material be returned to the originating process as feedstock also creates some confusion. Materials that are used as feedstocks are essentially being reclaimed. Because they are in somewhat "raw" form, their state is considered to be more virgin-like than waste-like; thus, the reclamation of the originating process is viewed as a production process. If a material is used as a feedstock or ingredient in a nonoriginating or secondary process, however, it is viewed as a reclamation step. EPA's decision in this matter is again dictated by the concern for "sham" operations. No consideration is given for the equivalency of the waste material used in the secondary process to the other "virgin" materials used. Thus, an emission control dust (baghouse dust) that may be obtained from one smelter operation used in the same originating operation would not be considered to be a solid waste. A baghouse dust from another facility, shipped to a smelter for use in the smelting process, would be deemed to be reclamation and would thus need to be manifested.

B. Effect on Recyclers

Because many of the wastes shipped to recyclers can now be defined as solid wastes, the company accepting the wastes for recycling would now be accepting manifested wastes. Thus, the recycling company's name appears on the manifest. It is not clear at this time to what extent the recycling company bears liability for future damages resulting from the waste materials associated with the recycling operation. For example, a reclaiming operation accepting spent solvent would generate still bottoms that it may ship offsite for landfilling. Although the generator shares in the fear that it may have to pay if the recycler goes out of business, the recycler may fear the same thing: what happens if the generator goes out of business? Under the "strict, joint, and several" liability provision of Superfund, the recycler may be liable as well. There may be some reclaimers who have not had to worry about this situation, because the wastes they accepted were previously exempted from the manifesting requirements. They are now in the position of having to accept a manifested hazardous waste that bears their company's name on it. The fear of future liability may be viewed by these recyclers as a constraining factor, and they may decide not to accept the now manifested wastes that before the revised definition they had processed. If such behavior is common, the consequence of this reaction will affect generators who may still choose to ship wastes offsite for recycling, but may be severely limited in their choices as to where to send it.

As mentioned above, a TSDF permit is not necessary for the reclamation activity itself. Such a permit is required, however, if the recyclers store any of the hazardous materials they receive for any amount of time prior to processing it. Although many reclaiming operations would process the materials directly, there may still be instances in which substances must be stored prior to processing, depending on the size of the facility and the volumes it receives. Discussions with EPA (personal communication with Matt Straus, U.S. EPA, July 26, 1985) indicate that there may be increased incidents of "disguised" storage, in which recyclers state that the material contained in a tank is undergoing reclamation. With the prospect for such claims being made, additional regulations or criteria may then be necessary to determine what is legitimate reclamation or processing as opposed to storage. An example of an ambiguous situation is one in which material in a tank is settled and decanted. The question remains as to whether settling will be considered a legitimate recovery operation, or whether it will be judged to be storage, and hence regulated if placed in the tank prior to processing.

C. Effect on Waste Exchanges

Because the end use and recycling method of the waste material must be known in order to determine whether or not the recycling of such material qualifies it as a solid waste, the use of material exchanges may diminish considerably. Material exchanges take physical possession of the waste and broker it to companies that could use it. The generator transferring the material to such an exchange would not know whether the material would qualify as a solid waste (thus requiring manifesting), unless it were known how the waste is to be recycled and what would be the end use of the recovered materials.

In the case of information exchanges, there is more likelihood that the ultimate disposition of the waste could be learned in advance, depending on whether the exchange is passive or active. In a passive exchange, the generator bears the burden for contacting the interested party, so that there would be communication between the parties exchanging the waste. Some active exchanges arrange for the transfer of the waste, with the identities of the buyer and seller kept confidential. This type of arm's-length transaction is likely to become less attractive.

IV. Summary and Conclusions

Although the new definition may be needed to prevent abuse of recycling operations, it may be seen by some companies as discouraging recycling and resource recovery efforts. Also, the complexity of the definition lends itself to misinterpretation. This misinterpretation leads to perceptions of constraints that do not really exist. Section 5.3 of Volume 1 (Organizational and Attitudinal Aspects) discusses these perceptions and their implication for industry actions in more detail.

The definition at this time contains no mechanism for consideration of equivalent uses of waste materials. In this regard, the definition may carry with it some of the inequities and biases possibly inherent in the RCRA statute itself. For example, RCRA requires that regulations governing the recycling of used oil do not discourage the recovery or recycling of used oil consistent with the protection of human health and the environment (Section 3014(a) of RCRA). As a consequence of this language, proposed regulations relating to the burning and blending of hazardous wastes as fuels do not require "full" compliance with the manifesting requirements of RCRA (November 29, 1985 at 50 FR 49231). No such privileges are granted at this time toward other substances that are recycled. Thus, there appears to be an inequity in that products and raw materials (as opposed to waste products and spent materials) that may be every bit as hazardous, if not more hazardous, than comparable waste streams, are not required to obtain the same degree of permitting, tracking, review, and regulation as the waste streams. A tank car transporting virgin trichloroethane, for example, for use in a process is not subject to the same degree of manifesting requirements as is a tank car transporting spent trichloroethane being sent to a solvent recovery facility for reclamation.

On the other hand, byproducts that are used directly in other processes without additional reclamation are excluded from the definition of solid wastes. Problems, therefore, center around what is considered to be reclamation. Also, the ultimate end use of the product in which the waste material is introduced determines whether it falls under the solid waste definition. As a result, the regulated community may be more concerned with escaping regulation, even when the opportunity exists to recycle.

The new definition of hazardous and solid wastes, however, may provide an additional incentive to onsite recycling, even where it might not otherwise be economically justified, or where the scale of operation involved may not allow the fullest reduction in the volume of the waste that must be disposed of after recovery. Unlike the April 1983 proposal, the final rule classifies wastes in such a way that, for example, waste solvents sent to recyclers for batch tolling must be manifested--even when the recovered solvent is being returned to the originating company. Some recyclers have noted to Versar in interviews that their business base involves receiving the majority of their gross income (i.e., 80 percent) from a relatively small number of large companies (comprising about 20 percent of total customers). For these customers, the fact that wastes recycled offsite face regulatory requirements that wastes recycled onsite do not face shifts the economic balance. This shift occurs even where the ability to recycle process residues may not be as great as that of a larger recycler. Even smaller companies are beginning to look at the possibility of installing small distilling units, which will leave relatively large proportions of the waste stream unrecovered. Unfortunately, such companies are probably considering the short-term costs and liabilities of the manifesting requirements, and ignoring the likely long-term increasing costs for disposing of the larger proportion of wastes from the onsite process. (Recyclers in

California, while agreeing on this impact generally, note that the new Federal requirement makes no difference there, since manifesting was already required by the State.)

The definition, in summary, contains both constraints and incentives. It is perceived mostly as a constraining mechanism, which, in tandem with other aspects such as liability, siting, and permitting, may contribute to a general attitude against consideration of certain recycling practices.

APPENDIX G

CORRESPONDENCE FROM EPA ON WASTE MINIMIZATION ACTIVITIES

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

MAR 1 · 1985

OFFICE OF
SOLID WASTE AND EMERGENCY RESPONSE

Mr. William Stough
Director
Great Lakes Regional Waste Exchange
3250 Townsend N.E.
Grand Rapids. Michigan 49505

Dear Mr. Stough

It was a pleasure to hear from you and learn of your interest in using waste exchange programs to support the waste minimization concept of the Resource Conservation and Recovery Act (RCRA) Reauthorization.

Where participation in a waste exchange program affects a generator's efforts to reduce the volume or toxicity of hazardous waste. such participation may be used to satisfy Section 3002(b)(1) of RCRA. Participation in a waste exchange program could also be used as evidence of compliance with §3002(b)(2). which requires that the generator select the method of treatment. storage or disposal which minimizes the threat to human health and the environment.

It is our hope that each year greater volumes of hazardous waste will be recycled. reclaimed and reused through waste exchange programs. Achievement of this goal will go a long way toward meeting the intent of Congress regarding the disposal of hazardous waste in or on the land.

We appreciate hearing from you. If you have further questions. please let me know.

Sincerely yours,

Michael Bloch
for
John H. Skinner
Director
Office of Solid Waste (WH-562)

Fyi

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

JUL 11 1985

OFFICE OF
SOLID WASTE AND EMERGENCY RESPONSE

Mr. R. R. Saulsman, Manager
Energy & Environmental Affairs
The Boeing Company
P. O. Box 3707
Seattle, Washington 98124-2207

Dear Mr. Saulsman:

Thank you for your letter of June 5, 1985, concerning the waste minimization statement which generators will be required to sign on the Uniform Hazardous Waste Manifest (UHWM) effective September 1, 1985.

As you indicated when you originally spoke to Carolyn Barley in May, your concern was that Boeing Company employees would be reluctant to sign this statement because as individuals they do not have a waste minimization program in place as required by the statement. Our suggestion in response to your concern was for the employee signing the statement to include under the signature line in Item 16 the phrase, "on behalf of The Boeing Company." You indicated in your letter that this solution is satisfactory provided that this phrase can be preprinted on the form. Of course, the individual signing the statement is responsible for the veracity of the statement, as is the company.

We recognize that preprinting this phrase on the form would be a more efficient and less time consuming procedure than requiring Boeing employees to write it in by hand. Additionally, the Agency's March 20, 1985, regulations on the UHWM do not specifically preclude you from preprinting this phrase on the form. Therefore, I have no objections to your proposal.

If you have other questions about the waste minimization statement or the UHWM system, I suggest that you again contact Carolyn Barley (202-382-2217).

Sincerely yours,

for Michael B Cook
John H. Skinner
Director
Office of Solid Waste

G-2

Mr. Peter Ashbrook
Head, Hazardous Waste Management
University of Illinois
317 McKinley Hospital
1109 South Lincoln Avenue
Urbana, Illinois 61801

Dear Mr. Ashbrook:

Thank you for your letter of August 26, 1985, to Lee Thomas concerning the availability of guidance on implementation of waste minimization practices at the University of Illinois. I am sympathetic to the challenge you face in managing a large variety of relatively small quantity wastes that, in total, represent a significant quantity.

The Hazardous and Solid Waste Amendments (HSWA) of 1984, establish as national policy the minimization of hazardous waste. The legislation requires waste minimization considerations to be addressed in the Resource Conservation and Recovery Act (RCRA) transport manifests, generator reports, and permits.

The Agency has not developed guidance on waste minimization activities that may be practiced by generators and, at this time, does not intend to. Instead, it is hoped that activities such as source reduction and recycling will be explored by individual generators to reduce the volume or quantity and toxicity of the hazardous waste generated.

Senate Report No. 284, 98th Congress, 1st Session 66 (1983), articulates Congress' intent with regard to the waste minimization requirements in the HSWA. As this legislative history states, both minimization requirements for the manifest and biennial report refer to a certification by the generator that a program is in place to reduce the volume or quantity and toxicity of hazardous waste to the degree determined by the generator to be economically practicable. While the requirement to make this certification is mandatory, the determination of what waste minimization practices are economically practicable are to be made solely by the generator.

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Final:elw:9/6/85

The legislative history makes clear that Congress' objective in enacting the requirement for waste minimization certification is to encourage generators of hazardous waste to voluntarily reduce the quantity and toxicity of waste generated.

As the legislative history suggests and as the Environmental Protection Agency (EPA) has stated, generators that recycle wastes on-site, send their wastes off-site to be recycled or participate in a waste exchange program are exercising a form of waste minimization that may be used to satisfy the waste minimization certification requirement, and may certify as such.

In addition to the requirements for waste minimization certification imposed by the HSWA, the Amendments also require that a "Report to Congress" be submitted by the EPA by October 1, 1986, assessing the feasibility of establishing waste minimization regulations.

The Office of Solid Waste (OSW) is undertaking extensive technical studies on waste minimization practices including source reduction and recycling in support of the "Report to Congress. These studies will identify and assess current waste minimization practices for generators of hazardous waste. These activities include: good housekeeping practices, source reduction strategies and recycling opportunities for generators. They will also identify generic and specific problems associated with the implementation of waste minimization strategies. In addition, the studies will assess the potential for further applications of the identified waste minimization strategies and will evaluate what steps can be taken to mitigate problems and promote the increased use of waste minimization. This information, as well as recommendations for legislative changes or new regulatory intiatives will be presented in Report to Congress due October 1, 1986. In the interim, OSW will distribute information regarding specific waste minimization practices identified through our technical support studies and technology transfer seminars.

The Agency appreciates your concern with the waste minimization certification requirement. If you should have any further questions, please contact James Berlow, Manager of the Treatment, Recycling, and Reduction Program at (202) 382-7917.

Sincerely,

J. Winston Porter
Assistant Administrator

Mr. William Stough
Director
Great Lakes Regional Waste Exchange
3250 [illegible]
Grand Rapids, Michigan 49505

MAR 1 1985

Dear Mr. Stough:

It was a pleasure to hear from you and learn of your interest in using waste exchange programs to support the waste minimization concept of the Resource Conservation and Recovery Act (RCRA) Reauthorization.

Where participation in a waste exchange program affects a generator's efforts to reduce the volume or toxicity of hazardous waste, such participation may be used to satisfy Section 3002(b)(1) of RCRA. Participation in a waste exchange program could also be used as evidence of compliance with §3002(b)(2), which requires that the generator select the method of treatment, storage or disposal which minimizes the threat to human health and the environment.

It is our hope that each year greater volumes of hazardous waste will be recycled, reclaimed and reused through waste exchange programs. Achievement of this goal will go a long way toward meeting the intent of Congress regarding the disposal of hazardous waste in or on the land.

We appreciate hearing from you. If you have further questions, please let me know.

Sincerely yours,

John H. Skinner
Director
Office of Solid Waste (WH-562)

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Regional Waste Management Division Directors, Regions I-X
Gene Lucero, OWPE

REVISED by Steve Levy:cc:2-11-85
Revised by Clem Rastatter:cc:2-13-85
Required Concurrences:OGC: Mike Cook:elw:2/28/85

Mr. William Stough
Director
Great Lakes Regional Waste Exchange
3250 [illegible]
Grand Rapids, Michigan 49505

MAR 1 1985

1 [illegible]5

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

Fyi

JUL 11 1985

OFFICE OF
SOLID WASTE AND EMERGENCY RESPONSE

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Energy & Environmental Affairs
The Boeing Company
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We recognize that preprinting this phrase on the form would be a more efficient and less time consuming procedure than requiring Boeing employees to write it in by hand. Additionally, the Agency's March 20, 1985, regulations on the UHWM do not specifically preclude you from preprinting this phrase on the form. Therefore, I have no objections to your proposal.

If you have other questions about the waste minimization statement or the UHWM system, I suggest that you again contact Carolyn Barley (202-382-2217).

Sincerely yours,

Michael B Cook
for
John H. Skinner
Director
Office of Solid Waste

UNITED S[illegible]TES ENVIRONMENTAL PROTECTION A[illegible]NCY

AUG 5 1985

Ms. Faith Gavin Kuhn
Executive Director/Editor
National Association of Solvent Recyclers
1333 New Hampshire Avenue, N.W.
Suite 1100
Washington, D.C. 20036

Dear Ms. Kuhn:

Thank you for your letter of July 19, 1985, requesting clarification on the types of activities that may be used to satisfy the waste minimization certification as required by the Hazardous and Solid Waste Amendments (HSWA) of 1984. In addition, thank you for the copy of the National Association of Solvent Recyclers' (NASR) latest industry brochure and membership list.

The HSWA establish as national policy the minimization of hazardous waste. The legislation requires waste minimization considerations to be addressed in the Resource Conservation and Recovery Act (RCRA) transport manifests, generator reports, and permits.

Senate Report No. 284, 98th Congress, 1st Session 66 (1983), articulates Congress' intent with regard to the waste minimization requirements in the HSWA. As this legislative history states, both minimization requirements for the manifest and biennial report refer to a certification by the generator that a program is in place to reduce the volume or quantity and toxicity of hazardous waste to the degree determined by the generator to be economically practicable. While the requirement to make this certification is mandatory, the determination of what waste minimization practices are economically practicable are to be made by the generator. The legislative history makes clear that Congress' objective in enacting the requirement for waste minimization certification is to encourage generators of hazardous waste to voluntarily reduce the quantity and toxicity of waste generated.

[illegible] Written by Elaine Eby/P.Key CONTROLS ONLY Disk #1
WH-565A/OSW-WTB-WMED/Room 2811/Phone: 382-7917/plk/8-2-85

CONCURRENCES

SYMBOL	WH-565A E.Eby	WH-565A PHansen	WH-565 JLehman					
SURNAME	E. Eby	Hansen	Lehman					
DATE	8/2/85	8/2/85	8/2/85					

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As we previously discussed, and as the legislative history suggests, generators that either recycle wastes on-site or send their wastes off-site to be recycled are exercising a form of waste minimization that may be used to satisfy the waste minimization certification requirement, and may certify as such on the uniform hazardous waste manifest.

The Agency appreciates NASP's concern with the waste minimization certification requirement. If you have any further questions, please let me know.

Sincerely,

John H. Skinner
Director
Office of Solid Waste (WH-562)

APPENDIX H

COMPILATION OF INDUSTRIAL WASTE REDUCTION CASES

APPENDIX H - Compilation of Industrial Waste Reduction Cases.

Case No	Ref	Company and Location	SIC Code	Product	Waste Minimization Method Description	Waste Reduction		Classification	Number of Employees	Year (*)	Objective (**)	Capital Investment ($ 1,000)	Annual Cost Savings ($ 1,000)	Payback Period
						Percent	Quantity							
1	1	Climax Molybdenum Co., Leadville, Colo.	1061	Raw molybdenum, copper, zinc, iron, manganese	Installation of interceptor canals to pass runoff water through ion exchange unit. Other separation of heavy metals through coagulative electrolytic processing.	93.2 (Cu) 99.9 (Fe) 99.9 (Mn) 93.4 (Zn) 90.3 (Mb) 96.4 (Cn)		Treatment			YM			
2	1	United Globe Corp., Lexington, N.C.	251	Furniture	Incineration of process water waste solids and solvent wastes to produce steam for use in plant.	95.0% by volume	1.5 MM lb/yr	Treatment		1982	WM	1,500	905	<3 yrs
3	1	West Point Pepperell, Lumberton, N.C.	266	Textile dye and finishing	Establishment of Toxic Chemicals Review Committee.			Good operating practice	22,000	1975	WM	No change		
4	1	Rexham Corp., Greensboro, N.C.	275	Specialized product labels	Substitution of water-borne ink for alcohol/acetone ink. Distillation to recover n-propyl alcohol from waste inks for reuse in the process.		13,000 gal/yr (solvent)	Process modif. (recovery/reuse)		a1976	WM,Tech.	16	15	<1 yr
5	1	Exxon Chemical America, Linden, N.J.	2869	Solvents,chemical additives	Equipment redesign to retain solvents. Employee stewardship program, where organics are monitored at different stations.		1.5 MM lb/yr (total)	Process modif. Good operating practice	150,000	1975	WM	5 - 13	150	<1 yr
6	1	Allied Chemical Corp.,Metropolis, Ill.	2819	Chemicals,nuclear fuel	Recycling of waste calcium fluoride into anhydrous hydrofluoric acid production at another facility.		1,000 cu yd/mo recycled	Recycling		a1976	WM	4,300	1,000	4.5 yrs
7	1	Borden Chemical Co., Fremont, Calif.	2869	Urea, phenolic resins	Filter rinse and reuse of phenolic resins. Implementation of 2-stage tank rinsing. Employee education in waste reduction.	95.0		Process modif. Process modif. Good operating practice			WM			
8	1	America Euka Co., Euka, N.C.	2824	Nylon yarn	Recycling of solvents using in-house distillation.		10,000 gal/yr	Process modif.		1983	YM	7.5	90	1 month
9	1	Riker Laboratory, Northridge,Calif.	2834	Pharmaceuticals	Substitution of water-based solvent for organic-based solvent in tablet coatings.		24 ton/yr	Process modif.			WM		15	<1 yr
10	1	USS Chemicals, Haverhill, Ohio	2869	Phenol, aniline, related products	Control of organic vapors through addition of adsorption unit, scrap condenser, and floating roofs on storage tanks.	80.0 (air emission)		Process modif.			WM		175/100	1 month/ 18 days

(*) a:after;b:before / (**) WM:waste minimization;Tech:technical improvement;YM:yield maximization.

APPENDIX H (continued).

Case No	Ref	Company and Location	SIC Code	Product	Waste Minimization Method Description	Waste Reduction		Classification	Number of Employees	Year (*)	Objective (**)	Capital Investment ($ 1,000)	Annual Cost Savings ($ 1,000)	Payback Period
						Percent	Quantity							
11	1	Industrial and Agricultural Chemicals, Inc., Red Springs, N.C.	287	Trace elements sold to fertilizer industry	Use of inorganic chemical wastes from other industries to process out trace elements -- reduction in raw materials costs.			Process modif.			YM	No change		
12	1	ICI Americas, Inc. Goldsboro, N.C.	2879	Agricultural R&D	Etablishment of Environmental Compliance Committee. Waste stream segregation to prevent cross-contamination and to allow off-site distillation.	70.0	7700 gal/yr	Good operating practice		1984	WM	Minimal	37	Immediate
13	1	Daly-Herring Co., Kinston, N.C.	2879	Pesticides	Separation of waste dust streams to allow reuse of dust.		45,000 lb/yr waste dust	Good operating practice (recovery/reuse)		1983	WM	9.6	11.638	10 months
14	1	Texasgulf, Saltville, Va.	2879	Defluorinated phosphate	Closed-loop recycling system installed to remove inorganic fluorides from process water discharge stream.		280,000 gal/day	Process modif.			WM		2,000	1 yr
15	1	Florida Steel Corp., Charlotte, N.C.	3312	Steel	Resale of collected high-zinc furnace dust instead of land filling.			Recycling/reuse			WM	No change	129.6	Immediate
16	1	Waupaca Foundry, Waupaca, Wis.	3321	Grey & compacted graphite iron casting	Separation of wastewater to reduce amount requiring treatment to 25%.			Good operating practice		1980	WM, Tech.		20.995	3.5 yrs
17	1	Stanadyne, Inc., Sanford, N.C.	3432	Plumbing products	Combination of equipment installations and revised operating procedures to reduce sludge volume and cyanide concentrations from plating operations.	46.0		Process modif. Good operating practice		1982	WM			
18	1	Elkhart Products Div., Inc., Elkhart, Ind.	3471	Pipe fitting fabrication	Process redesign for waste reduction in combination with electrolytic recovery of copper.		182,000 gal/yr	Process modif. (recovery/reuse)		1979	WM	60	120	0.5 yr
19	1	Pioneer Metal Finishing, Inc., Franklinville, N.J	3471	Electroplating job shop	Replacement of single-pass continuous treatment system with closed-loop batch treatment systems.	50.0 (sludge)	40,000 gal/yr (sludge)	Process modif. Treatment			WM	210	52.460	3 yrs
20	1	Deere and Co., Moline, Ill.	3520 3530	Farm & construction equipment	Formation of a hazardous waste task force. Comprehensive treatment facility to reclaim and detoxify selected wastes.		330,000 gal/yr	Good operating practice Treatment		1980	WM	1,900	155.750	2.5 yrs
21	1	Hamilton Beach Div., Scovill, Inc. Clinton, N.C.	36	Small appliances	Off-site solvent recycling, plus substitution of water-based for solvent-based cleaners.		38,000 lb/yr (subst'n)	Recycling Process modif.			WM	3.250	20.260	5 months

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APPENDIX H (continued).

Case No	Ref	Company and Location	SIC Code	Product	Waste Minimization Method Description	Waste Reduction		Classification	Number of Employees	Year (*)	Objective (**)	Capital Investment ($ 1,000)	Annual Cost Savings ($ 1,000)	Payback Period
						Percent	Quantity							
22	1	Emerson Electric Co., Special Products Div., Murphy, N.C.	35 36	Metal finishing Stationery manufacture	Equipment installation for waste reduction/elimination plus a chemical waste management program and an incentive program for cost reduction or product ideas	100.0 solvent waste oil ZnCrO3	60 lb/dy (paint solids) 90 lb/dy (plating acid, oil, caustic) 720 lb/mo (solvent)	Process modif. Good operating practice			YM, WM	874	1,800	1.1-5 yrs
23	1	GTE Sylvania, Chicago, Ill.	3661	Electronic telephone switching equipment	Installation of closed-loop treatment system and electrolytic copper recovery system.		55 gal/wk (CuOH sludge)	Treatment Process modif. (recovery/reuse)		a1976	WM		6	
24	1	Data General Corp., Clayton, N.C.	3573 3679	Printed circuit boards.	Sale of untreated wastes, process changes to obtain marketable copper sludge.	100.0 (process waste-water)	400 ton/yr (landfill waste)	Process modif. Recycling		1981	WM	50	180	1.5 month
25	1	3M Corp., Columbia, Mo.	367	Microelectronics	Use of alternative cleaning equipment which uses furnace instead of hazardous solutions.		40,000 lb/yr	Process modif.			WM	59	15	3 yrs
26	1	Digital Equipment Corp., Tempe, Ariz.	3679	Printed wiring boards	Electrolytic recovery of Cu in treatment system, use of waste from other industries.			Process modif. (int. recycling)		a1976	YM			
27	1	Modine Manufacturing, Trenton, Mo.	3714	Metal radiators	Ion exchange and electrolytic equipment for recovery of copper.	100.0		Process modif. (int. recycling)			WM	27	22	14 months
28	1	Rexham Corp., Matthews, N.C.	3861	Laminated and coated paper, film, foil product	Solvent segregation, solvent vapor collection and sale, off-site distillation of solvent for reuse, incineration, comprehensive chemical waste management program.	60.0-65.0 (methyl ethyl ketone recovery)	4515 ton/yr (air emission)	Good operating practice Recycling/reuse		1979	WM			
29	1	Carolina Power & Light Co., New Hill, N.C.	4911	Electric power	Sale of fly ash and bottom ash for reuse.	30.0 (max)		Recovery/reuse		1979	YM, WM			
30	1	Duke Power Co.	4911	Electric power	Sale of fly ash and bottom ash, PCB incineration, waste stream segregation, revised equipment operation, establishment of an ongoing waste minimization program, reduction of radioactive waste.	95.0 (liquid rad. waste) 60.0	345,000 ton/yr (ash)	Good operating practice Recycling/reuse Treatment		1979	YM, WM	1,365	6,184	<1 yr

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APPENDIX H (continued).

Case No	Ref	Company and Location	SIC Code	Product	Waste Minimization Method Description	Waste Reduction		Classification	Number of Employees	Year (*)	Objective (**)	Capital Investment ($ 1,000)	Annual Cost Savings ($ 1,000)	Payback Period
						Percent	Quantity							
						(tritium and boron release)								
31	1	3M Corp., Columbia, Mo.	7374	Film developing unit of electronic products div.	Decanter system for gravity separation of solvent from water for reuse.			Process modif. (int. recycling)			YM, WM	4	12	0.25 yr
32	1	PCA International Inc,. Matthews, N.C.	7395	Mass portrait photography	Silver recovery through electrolysis and developer regeneration through ion exchange.		115,000 troy ounce silver 2919 gal/dy	Process modif. Treatment			WM			1 yr
33	1	American Fotokemi Inc., Elk Grove, Ill.	7399	Silver recovered from films and fixer solution	Centralization of silver recovery processing, improvement in treatment to extract nearly 100% of silver from solutions.			Treatment Process modif. (recovery/reuse)		a1976	YM	No change	6	Immediate
34	2	Allied Corp., Chemical Sector (North America)	2824	Chemicals	Sale of waste hydrochloric acid.	70.0		Recovery/reuse	14,000	b1967	YM			
			2819		Spent catalyst recovery for reuse.	100.0		Process modif.						
			2865		Combination fo hydrofluoric acid and calcium fluoride /lime into salable product.	100.0		Recovery/reuse						
			2869		Incineration of creosole, waste sludge for heat.		5000 MT/yr	Treatment						
					Use of byproduct sulfuric acid as process raw material	10.0		Process modif.						
					Recovery of spent 1,1,1-trichloroethane.	100.0		Process modif./ Good operating practice						
35	2	Amoco Chemicals Corp., Chicago, Ill.	2221	Industrial organic and other chemicals	Manufacturing process modification.	60.0-70.0		Process modif.	15,600	1980	YM			
			28		Reuse through sale.	60.0-70.0		Recovery/reuse						
			3079		Internal recycling.	90.0-100		Process modif.						
				Oil and lubricant additives	Incineration of organic waste as supplemental fuel.	70.0-80.0		Treatment						
					Reduction of waste sludge generation.	20.0-30.0								
36	2	AT&T Technologies Union, N.J.	3661	Telecommunication	Distillation of 1,1,1-trichloroethane.	95.0		Process modif.	365,000	1973	WM			
					Use of carbon adsorbers to capture solvent emmissions for reuse.	80.0-95.0		Process modif.						
					Treatment of plating rinse water.	99.0+		Treatment						
					Substitution of two polymers at 70 ppm into sludge for ferric chloride fed at 250-300 ppm at a waste treatment plant.			Treatment						
					Refinement of sludge for copper extraction.	100.0		Process modif.						
					Substitution of tin sulfamate for stannous fluoroborate for tin plating of copper wire.	100.0		Process modif.						
					Change in testing operation eliminated cable-end	50.0-75.0		Process modif.						

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APPENDIX H (continued).

Case No	Ref	Company and Location	SIC Code	Product	Waste Minimization Method Description	Waste Reduction		Classification	Number of Employees	Year (*)	Objective (**)	Capital Investment ($ 1,000)	Annual Cost Savings ($ 1,000)	Payback Period
						Percent	Quantity							
					cleaning step using 1,1,1-trichloroethane.									
37	2	Chevron Chemical Co., San Francisco, Calif.	2843 2869 2873 2874 2879	Agri. chemicals Fertilizers Home & garden consumer products Oil/fuel additive	Reformulation/repackaging of damaged containers and floor sweepings of pesticides.	~50.0		Process modif. (int. recycling)	3,200	1982	WM			
					Reuse of product samples taken during production runs.			Process modif.						
					Use of fertilizer tank bottom sludges as raw material for fertilizer.			Reuse						
					Recovery of oils.	64.0		Process modif.						
					Triple-rinsing of pesticide drums and return to manufacturer.	50.0		Recycling/good oper. practice						
					Solvent production process change.	60.0		Process modif.						
					Wastewater and solvent segregation.	13.0,52.0		Good oper. prac						
					Source control of wastewater.	16.0		Process modif./ good oper. prac						
					Rinse solutions from equipment cleaning used to make water-based products.	100.0		Reclamation						
					On-site distillation of solvents.			Process modif.						
					Reduce frequency of tank cleaning (sludge).	20.0		Good oper. prac						
					Biologifcal treatment of phenolic waste to reduce toxicity.			Treatment						
					Substitute returnable pesticide bulk tote bins for non-returnable drums.			Good oper. prac product subst'n						
38	2	Dow Chemical USA, Midland, Mich.	28 3079 3339	Organic, inorganic chemicals Plastic resins Non-ferrous metal Pesticides	Full range of activities.				30,000	1972	WM			
39	2	Eastman Chemicals Div., Eastman Kodak Co., Kingsport, Tenn.	28	Chemicals Fibers Plastics	Use of liquid waste as feedstock.	99.6		Reuse	17,000	b1983	WM			
					Solvent distillation.	99.0		Process modif.						
					Neutralization of liquid waste.	100.0		Treatment						
40	2	E.I du Pont de Nemours & Co.,Inc Wilmington, Del.	28 13 29	Fibers Industrial and consumer products Polymer products Agricultural and industrial chemicals Biomedical products Coal Petroleum product	Process change in ADN manufacture.	50.0 (water)		Process modif.	146,000	1980	YM			
					Marketing of landfilled waste, recycling of off-spec product.			Reclamation/ process modif.						
					Filtration of paint sludge, incineration of liquid.			Treatment						
					Pretreatment of waste aluminium oxide for sale to recycler.	100.0		Recycling/ treatment						
					Process change to reduce incinerator ash.	90.0		Process modif.						
					Sale of waste ferric chloride instead of ocean dumping			Recovery/reuse						
					Conversion of waste HCl into chlorine.		300Kton/yr	Reuse						
					Process modification to reduce load to treatment plant	20.0		Process modif.						

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APPENDIX H (continued).

Case No	Ref	Company and Location	SIC Code	Product	Waste Minimization Method Description	Waste Reduction Percent	Waste Reduction Quantity	Classification	Number of Employees	Year (*)	Objective (**)	Capital Investment ($ 1,000)	Annual Cost Savings ($ 1,000)	Payback Period
					Return of distillation residue to process as raw material.		4 MMlb/yr	Reuse/process modification						
					Neutralization of spent caustics for treatment.			Treatment						
					Storage of radioactive waste and reduce hazardous amount to one half.	50.0	312Kgal/yr	Good operating practice						
41	2	Exxon Chemical Americas, Houston Tex.	28 2221 2298 3079	Olefins, aromatics, polyolefins, elastomers, solvents, specialties, oil/fuel additives	Aluminium hydroxide removal from sludge for reclamation.	60.0		Process modif.	8,000	1982	WM			
					More selective polymerization technology to reduce generation of plastic byproduct.	65.0		Process modif.						
					Reformulation of end product to reduce hydrocarbon waste.	100.0		Process modif./ product subst'n						
					Reduction of carbon/water slurry by dewatering.	30.0		Treatment						
					Reduction of waste oil by operational optimizations.	40.0		Good operating practice/process modif.						
42	2	ICI Americas, Inc Wilmington, Del.	28	Agri. chemicals Pharmaceuticals Petrochemicals Fibers & textile chemicals Security devices Aerospace components	Input of waste back into process.	14.0,86.0 40.0,75.0		Reuse	6,000	b1984	WM			
					Sale of waste as feedstok to other process.	14.0,41.0		Recovery/reuse						
					New manufacturing processes and techniques.	70.0		Process modif./ good oper. prac						
					New procedures	52.0		Good operating practice						
43	2	3M Corp., St. Paul Minn.		Various	Development of the Pollution Prevention Pays (3P) program.			Process modif. (12) Product reform/ subst'n (9) Recovery/reuse (7)	50,000	1975	WM			
44	2	Occidental Chemical, Niagara Falls, N.Y.	28 29	Industrial and spec'lty chemical Durez resins and molding materials PVC resins and fabricated products Agricultural products	Segregation of liquid raffinate from phenol waste.	~33.0		Good operating practice	9,600	1979	WM			
					Incineration of liquid halogenated organics.	~10.0		Treatment						
					Sale of co-product waste stream dilutent.	~7.0		Recovery/reuse						
					Eliminate use of plasticizer, install water separation equipment to reduce volume and cross-contamination.	~2.5		Good operating practice						
					Detoxification of solids and contaminated water through hydrolysis, catalytic oxidation.	~1.8		Treatment						
					Detoxification of sludge from manufacture of inorganics to reduce chloride content.	~1.0		Treatment						
					Recovery and reuse of solvent.	~0.6		Recovery/reuse						
					Improved filtration stage, product recovery from			Process modif.						

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APPENDIX H (continued).

Case No	Ref	Company and Location	SIC Code	Product	Waste Minimization Method Description	Waste Reduction		Classification	Number of Employees	Year (*)	Objective (**)	Capital Investment ($ 1,000)	Annual Cost Savings ($ 1,000)	Payback Period
						Percent	Quantity							
					sodium chlorate sludge.									
45	2	Olin Corp., Stanford, Conn.	26 28 34	Chemicals Brass & stainless strip and mill products	Replacement of cyanides, solvent-based paints, raw material substitutions.			Process modif.	17,800	1983	WM			
					Waste solvents in electronics used for paints manufacture, refinery caustic used in wood pulping, paint sludge used as sealant.			Reuse						
					(etc.)			Process modif./good operating practice/treatment/recycling						
46	2	Rohm and Haas, Philadelphia, Pa.	28	Acrylic emulsions Surfactants Biocides Ion exchange resins Electro. & agri. chemicals (etc.)	Incineration of waste oils, spent solvents, still bottoms, polymers, and disposable process equipment.			Treatment	11,911	1983	WM			
					On-site neutralization or pH adjustment, then off-site biotreatment.			Treatment						
					Minimize maintenance using inorganic acid.			Good operating practice/process modif.						
47	2	Shell Oil Co., Houston, Tex.	12 13 28 29 646	Fuels & petrochemical feedstocks,aromatics Plastic, resins Agrichemicals (etc.)	Recovery of oil from tanks during cleaning.			Recovery/reuse	34,700	b1976	YM			
					Belt pressing and incineration of biosludge.	50 MM ton/yr		Treatment						
					Installation of incinerators in process units.			Treatment						
					Use of spent acids as feed for fresh acid.			Recovery/reuse						
					Use of spent caustic for pH control.			Recovery/reuse						
					Regeneration of catalysts.			Process modif.						
48	2	Union Carbide Corp., Danbury, Conn.	10 28 30 36	Carbons Commodity and specialty chemicals & plastics Electronics Home and auto products Industrial gases Processed metal ores	Change in operating configuration of biotreatment unit to reduce sludge generation.			Good operating practice	51,300	1981	WM			
					Material substitution to eliminate flammable liquid gas.			Process modif.						
					Catalyst improvement to reduce production of byproducts.			Process modif.						
49	2	Velsicol Chemical Corp., Chicago, Ill.	28	Pesticides Specialty chemicals	Refrigeration system on process vents to recover toluene.			Recovery/reuse/process modif.	1,600	1978	WM			
					Installation of equipment to recover and recycle spent hypochlorite.	43.0		Process modif.						
					Conservation and recycle improvements for water.	83.0,97.0		Process modif.						

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APPENDIX H (continued).

Case No	Ref	Company and Location	SIC Code	Product	Waste Minimization Method Description	Waste Reduction		Classification	Number of Employees	Year (*)	Objective (**)	Capital Investment ($ 1,000)	Annual Cost Savings ($ 1,000)	Payback Period
						Percent	Quantity							
					Installation of still bottoms reboiler and improved column internals.	44.0		Process modif.						
					Solvent recovery (distillation) out of liquid waste, which is incinerated.	53.0		Process modif./ treatment						
					Process change to reduce solvent and water usage.	100.0		Process modif.						
					Reaction of still bottoms to form saleable product.			Recovery/reuse						
					Collection and separation of equipment cleaning waste.			Good operating practice						
					Use of vent scrubber to recycle HCl, water to process.			Reuse						
					Replacement of bearing and seal systems to arrest leaks from bearing.	100.0		Good operating practice						
50	3	Model Blue Ribbon Cleaners	7216	Dry-cleaning services	Addition of refrigerated solvent recovery system.			Recovery/recycling						
51	3	California Electroplating, Los Angeles, Calif.	3471	Plating	Installation of 4 counterflow rinses after each plating stage, plus spray nozzles to wash drag-out back into tanks.			Process modif.						
52	3	Allied Metal Finishing, Baltimore, Md.	3471	Plating of parts	Installation of H.S.A reactor.		Cd<1.22ppm	Process modif. (recovery/reuse)					43.620	1.5 yrs
53	3	General Plating, Detroit, Mich.	3471	Metal plating	Installation of tising film evaporator unit.		350 lb/dy chromic acid	Process modif. (recovery/reuse)					>100	
54	3	Ford Motor Co., Sabine, Mich.	3471	Metal plating	Installation of evaporator recovery units.			Process modif. (recovery/reuse)						
55	3	Ford Motor Co., Sabine, Mich.	3471	Automotive parts plating	Installation of 3 evaporator recovery units.			Process modif.						
56	3	Advance Plating Co., Cleveland, Ohio	3471	Automotive parts plating	Attachment of Innova Chrome Napper ion transfer system to allow closed-loop recovery of chromium.	80.0-90.0 (Cr) 99.0 (water)		Process modif.						
57	3	Reliable Plating Works, Milwaukee, Wis.	3471	Plating of napkins, paper towels and toilet tissue dispensers	Attachment of Innova Chrome Napper ion transfer system to automatic hoist line.	80.0-90.0 (Cr) 99.0 (water)	39.4 kg/wk (H_2CrO_4) 92 Kl/dy	Process modif.						
58	3	Caterpillar Tractor Co.,		Paint application (engine)	Use of water-borne coatings.			Process modif.						

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APPENDIX H (continued).

Case No	Ref	Company and Location	SIC Code	Product	Waste Minimization Method Description	Waste Reduction		Classification	Number of Employees	Year (*)	Objective (**)	Capital Investment ($ 1,000)	Annual Cost Savings ($ 1,000)	Payback Period
						Percent	Quantity							
		Mossville, Ill.												
59	3	Flexsteel Industries, Dubuque, Iowa		Paint application (furniture)	Change from conventional air spray to electrostatic finishing system.	40.0 overspray		Process modif.					15	<2 yrs
60	3	Oshkosh Truck Corp., Oshkosh, Wis.	3713	Assembly of heavy specialty trucks	Purification of paint-laden air using water venturis, with water then electrostatically treated to remove floating overspray by skimming.			Treatment/ process modif.						
61	3	Fisher Body (GM). Lansing, Mich.	3711	Automobile bodies	Shift from solvent-borne-coating system to electro-coating, which uses water-bornes.			Process modif.						
62	3	USI Agribusiness, Atlanta, Ga.	2646 3523 3811	Poultry-feeding, egg collection, environmental control equipment	Shift to powder coating line.			Process modif.						
63	3	3M Corp., St Paul, Minn.		Various	Redesign of spray booth to reduce resin overspray and recycle overspray back into to process.		500 Klb/yr resin	Process modif./ recycling					125	
64	3	Colorcraft, Rockford, Ill.	7395	Photo finishing	Installation of production prototype developer recycling unit (electrodialysis).	80.0		Process modif. (int. recycling)					50	
65	3	Deluxe Motion Picture Laboratories, Hollywood Calif.	7819	Film processing	Introduction of ion exchange technology to purify waste washwater for reuse and recover silver.	62.0 (water) 90.0 (Ag)		Process modif. (int. recycling)						
66	3	PCA International Matthews, N.C.	7395	Photo finishing	Recycle bleaches. Recover silver from washwater. Recover heavy metals from wastewater. Recycle pre-bath, final bath, paper color developer. Total water recycle with 3-stage evaporation.	~100.0 (Ag) ~100.0 (water)		Process modif. (int. recycling/ reuse)						
67	3	Sweetheart Plastics, Conyers, Ga.	3079	Thermoformed packaging	Switch to 2-stage granulator design.	80.0 (scrap regrinding)		Process modif.					46	
68	3	Eastman Chemicals Kingsport, Tenn.			Production of thermoset polyester resins from used polyethylene containers.			Reuse						
69	3	Goodyear Tire and Rubber Co.,			Recycle of polyethylene bottles economically into fabric, auto parts, carpeting, home insulation, etc.			Reuse						

(*) a:after;b:before / (**) WM:waste minimization;Tech:technical improvement;YM:yield maximization.

APPENDIX H (continued).

Case No	Ref	Company and Location	SIC Code	Product	Waste Minimization Method Description	Waste Reduction		Classification	Number of Employees	Year (*)	Objective (**)	Capital Investment ($ 1,000)	Annual Cost Savings ($ 1,000)	Payback Period
						Percent	Quantity							
		Akron, Ohio												
70	3	Graphic Arts Technical Foundation, Pittsburgh, Pa.	27	Printing	Technical plant audits.			Good operating practice						
71	3	St. Petersburg Times, St. Petersburg, Fla.	27	Printed matter	In-house waste reduction program.	2.0 newsprint		Good operating practice						
72	3	The Oregonian, Portland, Oreg.	27	Printed matter	Introductin of anilox (flexography) inking device to reduce newsprint waste.	25.0		Process modif.						
73	3	Milwaukee Journal and Sentinel, Milwaukee, Wis.	27	Printed matter	In-house ink recycling.		54,000 gal/yr							
74	3	Charleston Newspaper, Charleston W. Va.	27	Printed matter	In-house ink recycling.			Process modif.						
75	3	Minneapolis Star and Tribune, Minneapolis, Minn.	27	Printed matter	Installation of fountain cleaner.	80.0 (ink)		Process modif.					350	
76	3	Union Carbide		Various	Mandated computer-assisted plant evaluation systems (to calculate material balances).			Good operating practice					2 per day	
77	3	IBM		Various	Use of computer to monitor continuous solvent intake for polishing, machining, and cleaning operations.			Good operating practice						
78	3	Shuford Mills, Hickory, N.C.	36	Tape	Installation of two carbon adsorption units for recovery of toluene.	95.0 efficient		Process modif.						4 yrs
79	3	Pierce Industries Inc., Walden, N.Y.	2514	Metal furniture	Installation of Detrex free board extension unit and a powered degreaser cover.		3300 gal/dy	Process modif.						
80	3	Sealed Power Corp Muskegon, Mich.	3592	Piston rings	Installation of Detrex free board chillers.		45 ppm under OSHA limit of 100	Process modif.						
81	3	Halstead Industries,	3443	Heat-transfer equipment	Installation of carbon adsorption system on continous-use degreaser.		75 ppm under OSHA	Process modif.					>25	

(*) a:after;b:before / (**) WM:waste minimization;Tech:technical improvement;YM:yield maximization.

APPENDIX H (continued).

Case No	Ref	Company and Location	SIC Code	Product	Waste Minimization Method Description	Waste Reduction Percent	Waste Reduction Quantity	Classification	Number of Employees	Year (*)	Objective (**)	Capital Investment ($ 1,000)	Annual Cost Savings ($ 1,000)	Payback Period
		Scottsboro, Ala.					limit of 100							
82	3	Foremost Screen Print Plant of Fieldcrest Mills, Stokesdale, N.C.	2261 2262	Screen printing of consumer cloth goods	Recycling of water after treatment.		175,000 gal/dy	Process modif.						
83	3	Hollytex Carpet Mills, Inc., Southampton, Pa.	227	Carpet	Recycling of wastewater using carbon adsorption unit, with incineration of carbon.	80.0		Process modif.						
84	3	J.P. Stevens Co., Clemson, S.C.	22	Textiles	Recovery and re-use of PVA size (sizing chemical) using ultra-filtration technology developed jointly by Clemson University, J.P. Stevens Co., Gaston County Dyeing Machine Co. and Union Carbide Corp., oil recovery/reuse from exhaust.		1,000 ton/yr	Process modif. (int. recycling)						
85	3	Spring Mills, S.C.	22	Textiles	Installation of Abcor System to recover PVA sizing chemical.	96.0		Process modif.						
86	3	Riegel Textile Co., La France, S.C.	22	Textiles	Installation of ultrafiltration plant for complete recycle of textile wastewater and for heat recovery (co-funded with USEPA).			Process modif.						
87	3	Lumberton Dyeing and Finishing Co. Lumberton, N.C.	22	Textiles	Installation of counterflow heat recovery system to heat process water with exhaust and to precipitate out hydrocarbon pollutants.			Process modif.						5 months
88	3	Gaston County, Stanley, N.C., Spinners Processing Co., Spindale, N.C.	226	Textile dyeing	Use of low-liquor dyeing technology, which increases dye efficiency, reduces water consumption, and emits less polluting wastestream.			Process modif.					3.6 per week	
89	3	Adams-Millis Hosiery Co., High Point, N.C.	22	Textiles	Reconstitution and reuse of dye baths an average of 15 times before discharge.	19.0 (dye) 35.0 chemical 43.0 (water)		Process modif. (int. recycling)						
90	3	La France Industries, La France, S.C.	22	Textiles	Ultrafiltration technology to achieve closed-cycle dyeing, ultrafiltration concentrates the dye solution and recycles waste water for reuse.			Process modif.					560	

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APPENDIX H (continued).

Case No	Ref	Company and Location	SIC Code	Product	Waste Minimization Method Description	Waste Reduction		Classification	Number of Employees	Year (*)	Objective (**)	Capital Investment ($ 1,000)	Annual Cost Savings ($ 1,000)	Payback Period
						Percent	Quantity							
91	3	Cone Mills, Greensboro, N.C. Dan River Textile Co., Greenville, S.C.	22	Textiles	Undergo recycling through redesign of rinse boxes to counter-current rinse system, dropping amount of rinsewater and producing concentrated feed for ultrafiltration.			Process modif.						
92	4	General Motors Corp., Warren, Mich.	37	Automobiles	Side-stream separator technology for control of coal-fired boiler particulate emissions.	38.0-62.0		Treatment						
93	4	Phelps Dodge Corp., Hidalgo, N. Mex.	33	Copper	Replacement of copper smelting using a reverberatory furnace by the Outokumpu flash smelting process to facilitate sulfur recovery and energy saving.			Process modif.						
94	4	Kennecott, Garfield, Utah	33	Copper	Use of the Noranda continous process for copper smelting to facilitate sulfur and energy saving.			Process modif.						
95	4	Ubia, Inc., Crankton , R.I.	3471	Electroplating Job shop	Replacement of counter-current flow rinsing by the Providence method, which removes the majority of contaminating dragout in small volume before using a flowing rinse to reduce wastewater volume and to alow for recovery of plating solution.	94.0 (waste-water)		Process modif.						
96	5	Du Pont, Petrochemicals' Victoria, Tex.	28	Petrochemicals	Use of a new process to produce adiponitrile (ADN) which eliminates one intermediate to reduce wastewater.	50.0 (waste-water)	400 gal/min	Process modif.						
97	5	Du Pont, Petrochemicals' Sabine, Tex.	28	Petrochemicals	Recovery and sale of alumina instead of off-side disposal.			Recovery/reuse						
					Distillation of waste materials to recover feed materials for other processes, burning of distillation residues for energy.	80.0		Recovery						
					Reduction in sludge volume using a belt-filter press.	55.6 35.0-40.0 (overall)		Treatment						
98	5	Du Pont's Cape Fear Plant, Wilmington, N.C.	28	Chemicals	Substitution of safer solvents and disposal of solvent on-site by incineration.			Process modif.						
					Incineration of acid waste, recovery of cobalt for reformulation as catalyst in dimethyl terephthalate (DMT) manufacturing process.			Recovery/reuse						
					Recovery of raw materials from byproduct stream in DMT manufacture, burning of off-gases to generate heat.			Recovery						

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APPENDIX H (continued).

Case No	Ref	Company and Location	SIC Code	Product	Waste Minimization Method Description	Waste Reduction		Classification	Number of Employees	Year (*)	Objective (**)	Capital Investment ($ 1,000)	Annual Cost Savings ($ 1,000)	Payback Period
						Percent	Quantity							
99	6	Monsanto, Baxley, Ga.	28	Paper chemicals	Sale of sodium hydroxide as a neutralizer instead of disposal.			Reuse					400	
100	6	Monsanto, Anniston, Ala.	2879	Pesticides	Recovery of sulfur waste to be used in parcithion insecticide manufacture.		5,000,000 lb/yr	Recovery/reuse						
101	6	Badische Corp.	28	Chemicals	Recovery of materials from waste, burning of waste as boiler fuel.			Recovery						
					Sale of by-products instead of disposal.	112 million lbs sold in 1981		Reuse						
					Sale of waste stream (sodium-organic-acid salt stream) instead of disposal.			Reuse					1,000	
102	6	Allied Corp.	28	Chemicals	Recovery of sulfuric acid from spent scrubbing medium generated from other firms.			Recovery						
103	6	Hercules, Inc.			Recovery of spent solvents by distillation.	~100.0 (solvent)		Recovery						
					Removal of organics from wastewater using biological treatment systems.			Treatment						
104	7	3M, St. Paul, Minn.		Various	Burning solvent-laden air (SLA) in boilers to recover energy and reduce emission level.			Reuse/treatment					155	
105	7	3M, Magnetic Materials Resources Div., Cottage Grove, Minn.			Recovery of ammonium sulfate from wastewater which is subsequently processed and sold as fertilizer.			Recovery/reuse						
106	7	3M, Decorative Products Div., Nevada, Mo.			Redesigning pan to reduce the amount of coating solution required and to decrease the pan clean-up time.								10	
107	7	3M, Riker Laboratories, Northridge, Calif.	28	Pharmaceuticals	Replacing solvent-based by a water-based medicine tablet coating to reduce air pollution and shorten clean-up time.			Product subst'n						
108	8	Rexham Corp., Sumter, S.C.	27	Printing	Recovery and sale of solvent vapors for reuse.			Recovery/reuse						
109	8	Southern Coating, Sumter, S.C.	2851	Paints, coatings	Recovery of solvent by distillation which is subsequently used for cleanup.			Recovery/reclamation						

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APPENDIX H (continued).

Case No	Ref	Company and Location	SIC Code	Product	Waste Minimization Method Description	Waste Reduction		Classification	Number of Employees	Year (*)	Objective (**)	Capital Investment ($ 1,000)	Annual Cost Savings ($ 1,000)	Payback Period
						Percent	Quantity							
110	8	Bowling Co., Mt. Olive, N.C.	2521	Wood office furniture	Recovery and reuse of spent acetone as thinner. Burning of spent lacquer for heat recovery.			Recovery/reuse Recovery/treatment						
111	8	Lenoir Minor,Co., Lenoir, N.C.	27	Printing	Recovery of xylene contaminated with paint by pot distillation.			Recovery						
112	8	Thiele-Engdahl, Winston-Salem, N.C.	2893	Solvent-based ink	Rcovery of spent isopropyl acetate by pot distillation. The solvent is resued for equipment cleanup.			Recovery/reuse						
113	8	Westinghouse Electric Meter Plant, Raleigh, N.C.	3825	Electric meters	Recovery of perchloroethylene and Freon TMS degreaser by distillation.			Recovery						
114	8	Celanese Fiber Operations, Charlotte, N.C.	2823 2824	Polyester resins and fibers, cellulosies.	Recovery of Freon TMC and Dowtherm solvents by distillation. Burning of concentrated MeO-acetone mixture in cement kilns for heat recovery.			Recovery Recovery/treatment						
115	8	Burlington Furniture Co., Lexington, N.C.	2521	Wood furniture	Burning of spent solvents for heat recovery.			ment						

(*) a:after;b:before / (**) WM:waste minimization;Tech:technical improvement;YM:yield maximization.

APPENDIX I

ENVIRONMENTAL AUDITING POLICY STATEMENT

federal register

Wednesday
July 9, 1986

Part IV

Environmental Protection Agency

Environmental Auditing Policy Statement; Notice

ENVIRONMENTAL PROTECTION AGENCY

[OPPE-FRL-3046-6]

Environmental Auditing Policy Statement

AGENCY: Environmental Protection Agency (EPA).

ACTION: Final policy statement.

SUMMARY: It is EPA policy to encourage the use of environmental auditing by regulated entities to help achieve and maintain compliance with environmental laws and regulations, as well as to help identify and correct unregulated environmental hazards. EPA first published this policy as interim guidance on November 8, 1985 (50 FR 46504). Based on comments received regarding the interim guidance, the Agency is issuing today's final policy statement with only minor changes.

This final policy statement specifically:

- Encourages regulated entities to develop, implement and upgrade environmental auditing programs;
- Discusses when the Agency may or may not request audit reports;
- Explains how EPA's inspection and enforcement activities may respond to regulated entities' efforts to assure compliance through auditing;
- Endorses environmental auditing at federal facilities;
- Encourages state and local environmental auditing initiatives; and
- Outlines elements of effective audit programs.

Environmental auditing includes a variety of compliance assessment techniques which go beyond those legally required and are used to identify actual and potential environmental problems. Effective environmental auditing can lead to higher levels of overall compliance and reduced risk to human health and the environment. EPA endorses the practice of environmental auditing and supports its accelerated use by regulated entities to help meet the goals of federal, state and local environmental requirements. However, the existence of an auditing program does not create any defense to, or otherwise limit, the responsibility of any regulated entity to comply with applicable regulatory requirements.

States are encouraged to adopt these or similar and equally effective policies in order to advance the use of environmental auditing on a consistent, nationwide basis.

DATES: This final policy statement is effective July 9, 1986.

FOR FURTHER INFORMATION CONTACT:

Leonard Fleckenstein, Office of Policy, Planning and Evaluation, (202) 382-2726;

or

Cheryl Wasserman, Office of Enforcement and Compliance Monitoring, (202) 382-7550.

SUPPLEMENTARY INFORMATION:

ENVIRONMENTAL AUDITING POLICY STATEMENT

I. Preamble

On November 8, 1985 EPA published an Environmental Auditing Policy Statement, effective as interim guidance, and solicited written comments until January 7, 1986.

Thirteen commenters submitted written comments. Eight were from private industry. Two commenters represented industry trade associations. One federal agency, one consulting firm and one law firm also submitted comments.

Twelve commenters addressed EPA requests for audit reports. Three comments per subject were received regarding inspections, enforcement response and elements of effective environmental auditing. One commenter addressed audit provisions as remedies in enforcement actions, one addressed environmental auditing at federal facilities, and one addressed the relationship of the policy statement to state or local regulatory agencies. Comments generally supported both the concept of a policy statement and the interim guidance, but raised specific concerns with respect to particular language and policy issues in sections of the guidance.

General Comments —

Three commenters found the interim guidance to be constructive, balanced and effective at encouraging more and better environmental auditing.

Another commenter, while considering the policy on the whole to be constructive, felt that new and identifiable auditing "incentives" should be offered by EPA. Based on earlier comments received from industry, EPA believes most companies would not support or participate in an "incentives-based" environmental auditing program with EPA. Moreover, general promises to forgo inspections or reduce enforcement responses in exchange for companies' adoption of environmental auditing programs—the "incentives" most frequently mentioned in this context—are fraught with legal and policy obstacles.

Several commenters expressed concern that states or localities might use the interim guidance to *require* auditing. The Agency disagrees that the policy statement opens the way for states and localities to require auditing. No EPA policy can grant states or localities any more (or less) authority than they already possess. EPA believes that the interim guidance effectively encourages *voluntary* auditing. In fact, Section II.B. of the policy states: "because audit quality depends to a large degree on genuine management commitment to the program and its objectives, auditing should remain a voluntary program."

Another commenter suggested that EPA should not expect an audit to identify all potential problem areas or conclude that a problem identified in an audit reflects normal operations and procedures. EPA agrees that an audit report should clearly reflect these realities and should be written to point out the audit's limitations. However, since EPA will not routinely request audit reports, the Agency does not believe these concerns raise issues which need to be addressed in the policy statement.

A second concern expressed by the same commenter was that EPA should acknowledge that environmental audits are only part of a successful environmental management program and thus should not be expected to cover every environmental issue or solve all problems. EPA agrees and accordingly has amended the statement of purpose which appears at the end of this preamble.

Yet another commenter thought EPA should focus on environmental performance results (compliance or non-compliance), not on the processes or vehicles used to achieve those results. In general, EPA agrees with this statement and will continue to focus on environmental results. However, EPA also believes that such results can be improved through Agency efforts to identify and encourage effective environmental management practices, and will continue to encourage such practices in non-regulatory ways.

A final general comment recommended that EPA should sponsor seminars for small businesses on how to start auditing programs. EPA agrees that such seminars would be useful. However, since audit seminars already are available from several private sector organizations, EPA does not believe it should intervene in that market, with the possible exception of seminars for government agencies, especially federal agencies, for which EPA has a broad mandate under Executive Order 12088 to provide technical assistance for environmental compliance.

Requests for Reports

EPA received 12 comments regarding Agency requests for environmental audit reports, far more than on any other topic in the policy statement. One commenter felt that EPA struck an appropriate balance between respecting the need for self-evaluation with some measure of privacy, and allowing the Agency enough flexibility of inquiry to accomplish future statutory missions. However, most commenters expressed concern that the interim guidance did not go far enough to assuage corporate fears that EPA will use audit reports for environmental compliance "witch hunts." Several commenters suggested additional specific assurances regarding the circumstances under which EPA will request such reports.

One commenter recommended that EPA request audit reports only "when the Agency can show the information it needs to perform its statutory mission cannot be obtained from the monitoring, compliance or other data that is otherwise reportable and/or accessible to EPA, or where the Government deems an audit report material to a criminal investigation." EPA accepts this recommendation in part. The Agency believes it would not be in the best interest of human health and the environment to commit to making a "showing" of a compelling information need before ever requesting an audit report. While EPA may normally be willing to do so, the Agency cannot rule out in advance all circumstances in which such a showing may not be possible. However, it would be helpful to further clarify that a request for an audit report or a portion of a report normally will be made when needed information is not available by alternative means. Therefore, EPA has revised Section III.A., paragraph two and added the phrase: "and usually made where the information needed cannot be obtained from monitoring, reporting or other data otherwise available to the Agency."

Another commenter suggested that (except in the case of criminal investigations) EPA should limit requests for audit documents to specific questions. By including the phrase "or relevant portions of a report" in Section III.A., EPA meant to emphasize it would not request an entire audit document when only a relevant portion would suffice. Likewise, EPA fully intends not to request even a portion of a report if needed information or data can be otherwise obtained. To further clarify this point EPA has added the phrase, "most likely focused on particular information needs rather than the entire report," to the second sentence of paragraph two, Section III.A. Incorporating the two comments above, the first two sentences in paragraph two of final Section III.A. now read: "EPA's authority to request an audit report, or relevant portions thereof, will be exercised on a case-by-case basis where the Agency determines it is needed to accomplish a statutory mission or the Government deems it to be material to a criminal investigation. EPA expects such requests to be limited, most likely focused on particular information needs rather than the entire report, and usually made where the information needed cannot be obtained from monitoring, reporting or other data otherwise available to the Agency."

Other commenters recommended that EPA not request audit reports under any circumstances, that requests be "restricted to only those legally required," that requests be limited to criminal investigations, or that requests be made only when EPA has reason to believe "that the audit programs or reports are being used to conceal evidence of environmental non-compliance or otherwise being used in bad faith." EPA appreciates concerns underlying all of these comments and has considered each carefully. However, the Agency believes that these recommendations do not strike the appropriate balance between retaining the flexibility to accomplish EPA's statutory missions in future, unforeseen circumstances, and acknowledging regulated entities' need to self-evaluate environmental performance with some measure of privacy. Indeed, based on prime informal comments, the small number of formal comments received, and the even smaller number of adverse comments, EPA believes the final policy statement should remain largely unchanged from the interim version.

Elements of Effective Environmental Auditing

Three commenters expressed concerns regarding the seven general elements EPA outlined in the Appendix to the interim guidance.

One commenter noted that were EPA to further expand or more fully detail such elements, programs not specifically fulfilling each element would then be judged inadequate. EPA agrees that presenting highly specific and prescriptive auditing elements could be counter-productive by not taking into account numerous factors which vary extensively from one organization to another, but which may still result in effective auditing programs. Accordingly, EPA does not plan to expand or more fully detail these auditing elements.

Another commenter asserted that states and localities should be cautioned not to consider EPA's auditing elements as mandatory steps. The Agency is fully aware of this concern and in the interim guidance noted its strong opinion that "regulatory agencies should not attempt to prescribe the precise form and structure of regulated entities' environmental management or auditing programs." While EPA cannot require state or local regulators to adopt this or similar policies, the Agency does strongly encourage them to do so, both in the interim and final policies.

A final commenter thought the Appendix too specifically prescribed what should and what should not be included in an auditing program. Other commenters, on the other hand, viewed the elements described as very general in nature. EPA agrees with these other commenters. The elements are in no way binding. Moreover, EPA believes that most mature, effective environmental auditing programs do incorporate each of these general elements in some form, and considers them useful yardsticks for those considering adopting or upgrading audit programs. For these reasons EPA has not revised the Appendix in today's final policy statement.

Other Comments

Other significant comments addressed EPA inspection priorities for, and enforcement responses to, organizations with environmental auditing programs.

One commenter, stressing that audit programs are *internal* management tools, took exception to the phrase in the second paragraph of section III.B.1. of the interim guidance which states that environmental audits can 'complement' regulatory oversight. By using the word 'complement' in this context, EPA does not intend to imply that audit reports must be obtained by the Agency in order to supplement regulatory inspections. 'Complement' is used in a broad sense of being in addition to inspections and providing something (i.e., self-assessment) which otherwise would be lacking. To clarify this point EPA has added the phrase "by providing self-assessment to assure compliance" after "environmental audits may complement inspections" in this paragraph.

The same commenter also expressed concern that, as EPA sets inspection priorities, a company having an audit program could appear to be a 'poor performer' due to complete and accurate reporting when measured against a company which reports something less than required by law. EPA agrees that it is important to communicate this fact to Agency and state personnel, and will do so. However, the Agency does not believe a change in the policy statement is necessary.

A further comment suggested EPA should commit to take auditing programs into account when assessing all enforcement actions. However, in order to maintain enforcement flexibility under varied circumstances, the Agency cannot promise reduced enforcement responses to violations at all audited facilities when other factors may be overriding. Therefore the policy statement continues to state that EPA may exercise its decretion to consider auditing programs as evidence of honest and genuine efforts to assure compliance, which would then be taken into account in fashioning enforcement responses to violations.

A final commenter suggested the phrase "expeditiously correct environmental problems" not be used in the enforcement context since it implied EPA would use an entity's record of correcting nonregulated matters when evaluating regulatory violations. EPA did not intend for such an inference to be made. EPA intended the term "environmental problems" to refer to the underlying circumstances which eventually lead up to the violations. To clarify this point, EPA is revising the first two sentences of the paragraph to which this comment refers by changing "environmental problems" to "violations and underlying environmental problems" in the first sentence and to "underlying environmental problems" in the second sentence.

In a separate development EPA is preparing an update of its January 1984 *Federal Facilities Compliance Strategy*, which is referenced in section III. C. of the auditing policy. The Strategy should be completed and available on request from EPA's Office of Federal Activities later this year.

EPA thanks all commenters for responding to the November 8, 1985 publication. Today's notice is being issued to inform regulated entities and the public of EPA's final policy toward environmental auditing. This policy was developed to help (a) encourage regulated entities to institutionalize effective audit practices as one means of improving compliance and sound environmental management, and (b) guide internal EPA actions directly related to regulated entities' environmental auditing programs.

EPA will evaluate implementation of this final policy to ensure it meets the above goals and continues to encourage better environmental management, while strengthening the Agency's own efforts to monitor and enforce compliance with environmental requirements.

II. General EPA Policy on Environmental Auditing

A. Introduction

Environmental auditing is a systematic, documented, periodic and objective review by regulated entities[1] of facility operations and practices related to meeting environmental requirements. Audits can be designed to accomplish any or all of the following: verify compliance with environmental requirements; evaluate the effectiveness of environmental management systems already in place; or assess risks from regulated and unregulated materials and practices.

Auditing serves as a quality assurance check to help improve the effectiveness of basic environmental management by verifying that management practices are in place, functioning and adequate. Environmental audits evaluate, and are not a substitute for, direct compliance activities such as obtaining permits, installing controls, monitoring compliance, reporting violations, and keeping records. Environmental auditing may verify but does not include activities required by law, regulation or permit (e.g., continuous emissions monitoring, composite correction plans at wastewater treatment plants, etc.). Audits do not in any way replace regulatory agency inspections. However, environmental audits can improve compliance by complementing conventional federal, state and local oversight.

The appendix to this policy statement outlines some basic elements of environmental auditing (e.g., auditor independence and top management support) for use by those considering implementation of effective auditing programs to help achieve and maintain compliance. Additional information on environmental auditing practices can be found in various published materials.[2]

Environmental auditing has developed for sound business reasons, particularly as a means of helping regulated entities manage pollution control affirmatively over time instead of reacting to crises. Auditing can result in improved facility environmental performance, help communicate effective solutions to common environmental problems, focus facility managers' attention on current and upcoming regulatory requirements, and generate protocols and checklists which help facilities better manage themselves. Auditing also can result in better-integrated management of environmental hazards, since auditors frequently identify environmental liabilities which go beyond regulatory compliance. Companies, public entities and federal facilities have employed a variety of environmental auditing practices in recent years. Several hundred major firms in diverse industries now have environmental auditing programs, although they often are known by other names such as assessment, survey, surveillance, review or appraisal.

While auditing has demonstrated its usefulness to those with audit programs, many others still do not audit. Clarification of EPA's position regarding auditing may help encourage regulated entities to establish audit programs or upgrade systems already in place.

B. EPA Encourages the Use of Environmental Auditing

EPA encourages regulated entities to adopt sound environmental management practices to improve environmental performance. In particular, EPA encourages regulated entities subject to environmental regulations to institute environmental auditing programs to help ensure the adequacy of internal systems to achieve, maintain and monitor compliance. Implementation of environmental auditing programs can result in better identification, resolution and avoidance of environmental problems, as well as improvements to management practices. Audits can be conducted effectively by independent internal or third party auditors. Larger organizations generally have greater resources to devote to an internal audit team, while smaller entities might be more likely to use outside auditors.

Regulated entities are responsible for taking all necessary steps to ensure compliance with environmental requirements, whether or not they adopt audit programs. Although environmental laws do not require a regulated facility to have an auditing program, ultimate responsibility for the environmental performance of the facility lies with top management, which therefore has a strong incentive to use reasonable means, such as environmental auditing, to secure reliable information of facility compliance status.

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[1] "Regulated entities" include private firms and public agencies with facilities subject to environmental regulation. Public agencies can include federal, state or local agencies as well as special-purpose organizations such as regional sewage commissions.

[2] See, e.g., "Current Practices in Environmental Auditing," EPA Report No. EPA-230-09-83-006, February 1984; "Annotated Bibliography on Environmental Auditing," Fifth Edition, September 1985, both available from: Regulatory Reform Staff, PM-223, EPA, 401 M Street SW, Washington, DC 20460.

EPA does not intend to dictate or interfere with the environmental management practices of private or public organizations. Nor does EPA intend to mandate auditing (though in certain instances EPA may seek to include provisions for environmental auditing as part of settlement agreements, as noted below). Because environmental auditing systems have been widely adopted on a voluntary basis in the past, and because audit quality depends to a large degree upon genuine management commitment to the program and its objectives, auditing should remain a voluntary activity.

III. EPA Policy on Specific Environmental Auditing Issues

A. Agency Requests for Audit Reports

EPA has broad statutory authority to request relevant information on the environmental compliance status of regulated entities. However, EPA believes routine Agency requests for audit reports [3] could inhibit auditing in the long run, decreasing both the quantity and quality of audits conducted. Therefore, as a matter of policy, EPA will *not* routinely request environmental audit reports.

EPA's authority to request an audit report, or relevant portions thereof, will be exercised on a case-by-case basis where the Agency determines it is needed to accomplish a statutory mission, or where the Government deems it to be material to a criminal investigation. EPA expects such requests to be limited, most likely focused on particular information needs rather than the entire report, and usually made where the information needed cannot be obtained from monitoring, reporting or other data otherwise available to the Agency. Examples would likely include situations where: audits are conducted under consent decrees or other settlement agreements; a company has placed its management practices at issue by raising them as a defense; or state of mind or intent are a relevant element of inquiry, such as during a criminal investigation. This list is illustrative rather than exhaustive, since there doubtless will be other situations, not subject to prediction, in which audit reports rather than information may be required.

EPA acknowledges regulated entities' need to self-evaluate environmental performance with some measure of privacy and encourages such activity. However, audit reports may not shield monitoring, compliance, or other information that would otherwise be reportable and/or accessible to EPA, even if there is no explicit 'requirement' to generate that data.[4] Thus, this policy does not alter regulated entities' existing or future obligations to monitor, record or report information required under environmental statutes, regulations or permits, or to allow EPA access to that information. Nor does this policy alter EPA's authority to request and receive any relevant information—including that contained in audit reports—under various environmental statutes (e.g., Clean Water Act section 308, Clean Air Act sections 114 and 208) or in other administrative or judicial proceedings.

Regulated entities also should be aware that certain audit findings may by law have to be reported to government agencies. However, in addition to any such requirements, EPA encourages regulated entities to notify appropriate State or Federal officials of findings which suggest significant environmental or public health risks, even when not specifically required to do so.

B. EPA Response to Environmental Auditing

1. General Policy

EPA will not promise to forgo inspections, reduce enforcement responses, or offer other such incentives in exchange for implementation of environmental auditing or other sound environmental management practices. Indeed, a credible enforcement program provides a strong incentive for regulated entities to audit.

Regulatory agencies have an obligation to assess source compliance status independently and cannot eliminate inspections for particular firms or classes of firms. Although environmental audits may complement inspections by providing self-assessment to assure compliance, they are in no way a substitute for regulatory oversight. Moreover, certain statutes (e.g. RCRA) and Agency policies establish minimum facility inspection frequencies to which EPA will adhere.

However, EPA will continue to address environmental problems on a priority basis and will consequently inspect facilities with poor environmental records and practices more frequently. Since effective environmental auditing helps management identify and promptly correct actual or potential problems, audited facilities' environmental performance should improve. Thus, while EPA inspections of self-audited facilities will continue, to the extent that compliance performance is considered in setting inspection priorities, facilities with a good compliance history may be subject to fewer inspections.

In fashioning enforcement responses to violations, EPA policy is to take into account, on a case-by-case basis, the honest and genuine efforts of regulated entities to avoid and promptly correct violations and underlying environmental problems. When regulated entities take reasonable precautions to avoid noncompliance, expeditiously correct underlying environmental problems discovered through audits or other means, and implement measures to prevent their recurrence, EPA may exercise its discretion to consider such actions as honest and genuine efforts to assure compliance. Such consideration applies particularly when a regulated entity promptly reports violations or compliance data which otherwise were not required to be recorded or reported to EPA.

2. Audit Provisions as Remedies in Enforcement Actions

EPA may propose environmental auditing provisions in consent decrees and in other settlement negotiations where auditing could provide a remedy for identified problems and reduce the likelihood of similar problems recurring in the future.[5] Environmental auditing provisions are most likely to be proposed in settlement negotiations where:

- A pattern of violations can be attributed, at least in part, to the absence or poor functioning of an environmental management system; or
- The type or nature of violations indicates a likelihood that similar noncompliance problems may exist or occur elsewhere in the facility or at other facilities operated by the regulated entity.

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[3] An "environmental audit report" is a written report which candidly and thoroughly presents findings from a review, conducted as part of an environmental audit as described in section II.A., of facility environmental performance and practices. An audit report is not a substitute for compliance monitoring reports or other reports or records which may be required by EPA or other regulatory agencies.

[4] See, for example, "Duties to Report or Disclose Information on the Environmental Aspects of Business Activities," Environmental Law Institute report to EPA, final report, September 1985.

[5] EPA is developing guidance for use by Agency negotiators in structuring appropriate environmental audit provisions for consent decrees and other settlement negotiations.

Through this consent decree approach and other means, EPA may consider how to encourage effective auditing by publicly owned sewage treatment works (POTWs). POTWs often have compliance problems related to operation and maintenance procedures which can be addressed effectively through the use of environmental auditing. Under its National Municipal Policy EPA already is requiring many POTWs to develop composite correction plans to identify and correct compliance problems.

C. Environmental Auditing at Federal Facilities

EPA encourages all federal agencies subject to environmental laws and regulations to institute environmental auditing systems to help ensure the adequacy of internal systems to achieve, maintain and monitor compliance. Environmental auditing at federal facilities can be an effective supplement to EPA and state inspections. Such federal facility environmental audit programs should be structured to promptly identify environmental problems and expeditiously develop schedules for remedial action.

To the extent feasible, EPA will provide technical assistance to help federal agencies design and initiate audit programs. Where appropriate, EPA will enter into agreements with other agencies to clarify the respective roles, responsibilities and commitments of each agency in conducting and responding to federal facility environmental audits.

With respect to inspections of self-audited facilities (see section III.B.1 above) and requests for audit reports (see section III.A above), EPA generally will respond to environmental audits by federal facilities in the same manner as it does for other regulated entities, in keeping with the spirit and intent of Executive Order 12088 and the EPA *Federal Facilities Compliance Strategy* (January 1984, update forthcoming in late 1986). Federal agencies should, however, be aware that the Freedom of Information Act will govern any disclosure of audit reports or audit-generated information requested from federal agencies by the public.

When federal agencies discover significant violations through an environmental audit, EPA encourages them to submit the related audit findings and remedial action plans expeditiously to the applicable EPA regional office (and responsible state agencies, where appropriate) even when not specifically required to do so. EPA will review the audit findings and action plans and either provide written approval or negotiate a Federal Facilities Compliance Agreement. EPA will utilize the escalation procedures provided in Executive Order 12088 and the EPA *Federal Facilities Compliance Strategy* only when agreement between agencies cannot be reached. In any event, federal agencies are expected to report pollution abatement projects involving costs (necessary to correct problems discovered through the audit) to EPA in accordance with OMB Circular A-106. Upon request, and in appropriate circumstances, EPA will assist affected federal agencies through coordination of any public release of audit findings with approved action plans once agreement has been reached.

IV. Relationship to State or Local Regulatory Agencies

State and local regulatory agencies have independent jurisdiction over regulated entities. EPA encourages them to adopt these or similar policies, in order to advance the use of effective environmental auditing in a consistent manner.

EPA recognizes that some states have already undertaken environmental auditing initiatives which differ somewhat from this policy. Other states also may want to develop auditing policies which accommodate their particular needs or circumstances. Nothing in this policy statement is intended to preempt or preclude states from developing other approaches to environmental auditing. EPA encourages state and local authorities to consider the basic principles which guided the Agency in developing this policy:

- Regulated entities must continue to report or record compliance information required under existing statutes or regulations, regardless of whether such information is generated by an environmental audit or contained in an audit report. Required information cannot be withheld merely because it is generated by an audit rather than by some other means.
- Regulatory agencies cannot make promises to forgo or limit enforcement action against a particular facility or class of facilities in exchange for the use of environmental auditing systems. However, such agencies may use their discretion to adjust enforcement actions on a case-by-case basis in response to honest and genuine efforts by regulated entities to assure environmental compliance.
- When setting inspection priorities regulatory agencies should focus to the extent possible on compliance performance and environmental results.
- Regulatory agencies must continue to meet minimum program requirements (e.g., minimum inspection requirements, etc.).
- Regulatory agencies should not attempt to prescribe the precise form and structure of regulated entities' environmental management or auditing programs.

An effective state/federal partnership is needed to accomplish the mutual goal of achieving and maintaining high levels of compliance with environmental laws and regulations. The greater the consistency between state or local policies and this federal response to environmental auditing, the greater the degree to which sound auditing practices might be adopted and compliance levels improve.

Dated: June 28, 1986.

Lee M. Thomas,

Administrator.

Appendix—Elements of Effective Environmental Auditing Programs

Introduction: Environmental auditing is a systematic, documented, periodic and objective review by a regulated entity of facility operations and practices related to meeting environmental requirements.

Private sector environmental audits of facilities have been conducted for several years and have taken a variety of forms, in part to accommodate unique organizational structures and circumstances. Nevertheless, effective environmental audits appear to have certain discernible elements in common with other kinds of audits. Standards for internal audits have been documented extensively. The elements outlined below draw heavily on two of these documents: "Compendium of Audit Standards" (©1983, Walter Willborn, American Society for Quality Control) and "Standards for the Professional Practice of Internal Auditing" (©1981, The Institute of Internal Auditors, Inc.). They also reflect Agency analyses conducted over the last several years.

Performance-oriented auditing elements are outlined here to help accomplish several objectives. A general description of features of effective, mature audit programs can help those starting audit programs, especially federal agencies and smaller businesses. These elements also indicate the attributes of auditing EPA generally considers important to ensure program effectiveness. Regulatory agencies may use these elements in negotiating environmental auditing provisions for consent decrees. Finally, these elements can help guide states and localities considering auditing initiatives.

An effective environmental auditing system will likely include the following general elements:

I. *Explicit top management support for environmental auditing and commitment to follow-up on audit findings.* Management support may be demonstrated by a written policy articulating upper management support for the auditing program, and for compliance with all pertinent requirements, including corporate policies and permit requirements as well as federal, state and local statutes and regulations.

Management support for the auditing program also should be demonstrated by an explicit written commitment to follow-up on audit findings to correct identified problems and prevent their recurrence.

II. *An environmental auditing function independent of audited activities.* The status or organizational locus of environmental auditors should be sufficient to ensure objective and unobstructed inquiry, observation and testing. Auditor objectivity should not be impaired by personal relationships, financial or other conflicts of interest, interference with free inquiry or judgment, or fear of potential retribution.

III. *Adequate team staffing and auditor training.* Environmental auditors should possess or have ready access to the knowledge, skills, and disciplines needed to accomplish audit objectives. Each individual auditor should comply with the company's professional standards of conduct. Auditors, whether full-time or part-time, should maintain their technical and analytical competence through continuing education and training.

IV. *Explicit audit program objectives, scope, resources and frequency.* At a minimum, audit objectives should include assessing compliance with applicable environmental laws and evaluating the adequacy of internal compliance policies, procedures and personnel training programs to ensure continued compliance.

Audits should be based on a process which provides auditors: all corporate policies, permits, and federal, state, and local regulations pertinent to the facility; and checklists or protocols addressing specific features that should be evaluated by auditors.

Explicit written audit procedures generally should be used for planning audits, establishing audit scope, examining and evaluating audit findings, communicating audit results, and following-up.

V. *A process which collects, analyzes, interprets and documents information sufficient to achieve audit objectives.* Information should be collected before and during an onsite visit regarding environmental compliance(*1*), environmental management effectiveness(*2*), and other matters (*3*) related to audit objectives and scope. This information should be sufficient, reliable, relevant and useful to provide a sound basis for audit findings and recommendations.

a. *Sufficient* information is factual, adequate and convincing so that a prudent, informed person would be likely to reach the same conclusions as the auditor.

b. *Reliable* information is the best attainable through use of appropriate audit techniques.

c. *Relevant* information supports audit findings and recommendations and is consistent with the objectives for the audit.

d. *Useful* information helps the organization meet its goals.

The audit process should include a periodic review of the reliability and integrity of this information and the means used to identify, measure, classify and report it. Audit procedures, including the testing and sampling techniques employed, should be selected in advance, to the extent practical, and expanded or altered if circumstances warrant. The process of collecting, analyzing, interpreting, and documenting information should provide reasonable assurance that audit objectivity is maintained and audit goals are met.

VI. *A process which includes specific procedures to promptly prepare candid, clear and appropriate written reports on audit findings, corrective actions, and schedules for implementation.* Procedures should be in place to ensure that such information is communicated to managers, including facility and corporate management, who can evaluate the information and ensure correction of identified problems. Procedures also should be in place for determining what internal findings are reportable to state or federal agencies.

VII. *A process which includes quality assurance procedures to assure the accuracy and thoroughness of environmental audits.* Quality assurance may be accomplished through supervision, independent internal reviews, external reviews, or a combination of these approaches.

Footnotes to Appendix

(*1*) A comprehensive assessment of compliance with federal environmental regulations requires an analysis of facility performance against numerous environmental statutes and implementing regulations. These statutes include:

Resource Conservation and Recovery Act
Federal Water Pollution Control Act
Clean Air Act
Hazardous Materials Transportation Act
Toxic Substances Control Act
Comprehensive Environmental Response, Compensation and Liability Act
Safe Drinking Water Act
Federal Insecticide, Fungicide and Rodenticide Act
Marine Protection, Research and Sanctuaries Act
Uranium Mill Tailings Radiation Control Act

In addition, state and local government are likely to have their own environmental laws. Many states have been delegated authority to administer federal programs. Many local governments' building, fire, safety and health codes also have environmental requirements relevant to an audit evaluation.

(*2*) An environmental audit could go well beyond the type of compliance assessment normally conducted during regulatory inspections, for example, by evaluating policies and practices, regardless of whether they are part of the environmental system or the operating and maintenance procedures. Specifically, audits can evaluate the extent to which systems or procedures:

1. Develop organizational environmental policies which: a. implement regulatory requirements; b. provide management guidance for environmental hazards not specifically addressed in regulations;

2. Train and motivate facility personnel to work in an environmentally-acceptable manner and to understand and comply with government regulations and the entity's environmental policy;

3. Communicate relevant environmental developments expeditiously to facility and other personnel;

4. Communicate effectively with government and the public regarding serious environmental incidents;

5. Require third parties working for, with or on behalf of the organization to follow its environmental procedures;

6. Make proficient personnel available at all times to carry out environmental (especially emergency) procedures;

7. Incorporate environmental protection into written operating procedures;

8. Apply best management practices and operating procedures, including "good housekeeping" techniques;

9. Institute preventive and corrective maintenance systems to minimize actual and potential environmental harm;

10. Utilize best available process and control technologies;

11. Use most-effective sampling and monitoring techniques, test methods, recordkeeping systems or reporting protocols (beyond minimum legal requirements);

12. Evaluate causes behind any serious environmental incidents and establish procedures to avoid recurrence;

13. Exploit source reduction, recycle and reuse potential wherever practical; and

14. Substitute materials or processes to allow use of the least-hazardous substances feasible.

(3) Auditors could also assess environmental risks and uncertainties.

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APPENDIX J

DESCRIPTIONS OF STATE PROGRAMS

APPENDIX J.1

CALIFORNIA

J.1 California

I. Legislative Background

California has been relatively active in efforts to promote hazardous waste minimization. State programs include land disposal restrictions, regulatory requirements for recycling some waste materials, different requirements for hazardous waste facilities, depending on the type of waste processed, and fee and tax assessments on generators and some disposal facilities. Financial assistance for the purchase of pollution control equipment and for research, development, and demonstrations of minimization technologies is also available in the forms of loans and grants. California is sponsoring a study for the establishment of a waste reduction program and already operates a waste exchange. Numerous publications are also available through the California Department of Health Services.

In California, the volume of proposed legislation relating to hazardous waste has increased dramatically in recent years. For the 1985 legislative session, approximately 300 bills were introduced that dealt in some way with toxic or hazardous contamination.

Significant pieces of hazardous waste legislation include the Hazardous Waste Control Act of 1977 and the Hazardous Substances Account Act of 1981. The former prescribed the regulation of hazardous waste by the State Department of Health Services, set hazardous waste transport and land disposal rules, and mandated that all recyclable materials be recycled where economically feasible. The Hazardous Substances Account Act established a State fund for site cleanups and specified a formula for taxes per ton of waste generated. Both acts have been significantly amended since they were passed. For example, sections of the State Health and Safety Code established by the California Hazardous Waste Control Act of 1977 have been altered by recent legislation that ties fees on hazardous waste generators to a variable base rate. Previously, the numerical amounts of these fees had been specified.

Phase-out of the land disposal of specified hazardous waste was not legislated, but rather was enacted by the Executive Order of former Governor Jerry Brown on the basis of a 1981 Department of Health Services study of land disposal alternatives.

II. Regulatory Programs

A. Land Disposal Restrictions

Title 22, Article 15, of Chapter 30, Division 4, of the State of California's hazardous and solid waste regulations specifies that the land disposal of certain specified wastes is to be banned. The article sets forth the following schedule:

June 1, 1983	Banning of wastes containing free cyanides.
January 1, 1984	Banning of toxic metal wastes and polychlorinated biphenyls (PCBs).
January 1, 1985	Banning of liquid wastes containing halogenated organic compounds.
July 1, 1985	Banning of organic sludges, solids containing halogenated organic compounds, and lab packs containing any of the restricted wastes.

The above schedule is contingent upon a determination by the Department of Health Services (DHS) that sufficient recycling and treatment capacity for the wastes listed above will be permitted and fully operational by the day the landfill restrictions take effect. In making its determination, the Department must consider:

- The technical feasibility of recycling or treatment to process substantially all wastes subject to the land disposal restriction;
- The proximity of adequate recycling and treatment facilities to the generators of the hazardous wastes; and
- The technical feasibility of reducing, recycling, or treating the hazardous wastes at the point of generation.

Revisions in the schedule to postpone the effective dates of the restrictions must be followed by written notification to registered treatment, storage, and disposal facilities within 15 days. At the time of this writing (December 1985), the effective date of the land disposal restrictions on organic sludges, solids containing halogenated organic compounds, and lab packs containing any of the restricted hazardous wastes, has been changed from July 1, 1985, to July 8, 1987.

Exemptions from the land disposal restrictions include (1) drilling fluids spent during exploration, development, and/or production of oil and gas, (2) mining overburden, and (3) contaminated soils from the cleanup of toxic disposal sites, unless it is determined that such soils can be recycled or treated. Variances for land disposal of the restricted wastes may be granted by the DHS after consideration of the following:

- The acute or chronic toxicity to humans, domestic livestock, and wildlife if the restricted waste is ingested, inhaled, or absorbed through the skin;
- The immobility of the restricted waste in the land disposal environment;
- The persistence of this restricted waste in the land disposal environment;
- The ability of constituents of the restricted waste to bioaccumulate in plants or animals; and
- The ability of the restricted waste to be isolated by land disposal.

In addition, in reviewing variance petitions, the DHS must consider the good faith efforts of the petitioner plus any economic hardship caused by the use of existing recycling or treatment facilities.

B. Formation of the Department of Waste Management

The formation of a new Department of Waste Management, as proposed by current Governor George Deukmejian, is an endeavor to steamline the administrative functions, reduce the costs, and increase the efficiency of the State's waste management program. Justification for the reorganization is based on the observation of current administrative inefficiencies, some of which are:

- The existence of 12 State agencies having duplicative and overlapping functions;
- The distribution of EPA funds to three State agencies, each of which pays administrative overhead;
- The duplication of inspections, permits, and cleanup orders; and
- An inadequate recognition of public health and environmental issues and slow progress in developing and implementing new hazardous waste technologies.

At the time of this writing (January 1986), the latest reorganization plan had been rejected by the State senate as incomplete; several political aspects are still being debated, most notably, the composition and authority of the administrative board of the toxics program.

C. Regulatory Promotion of Recycling

In California, generators of wastes deemed recyclable must recycle those wastes or must, by request of the Department of Health Services, provide written justification for not recycling them. Title 22, Article 12, of the State's hazardous and solid waste regulations contains a list of wastes that the State considers recyclable. The list comprises mainly organic wastes, alkalis, and unrinsed empty containers used for hazardous chemicals.

In addition, the Department of Health Services has modified its regulatory requirements relating to hazardous waste facilities in an effort to promote recycling. These modifications, which went into effect in late August 1985, include:

- Changing the title of facilities that recycle hazardous waste from "hazardous waste facility" to "resource recovery facility," provided certain specifications are met;
- Simplifying permit requirements for facilities that recycle non-RCRA hazardous wastes;
- Reducing permit requirements for facilities that handle large-volume, low-hazard materials or that use recyclable materials as substitutes for raw materials or commercial products; and

- Establishing certain requirements for the management of recyclable spent lead-acid storage batteries and waste elemental mercury.

Three series of resource recovery facilities are now defined: Series "A" for Federal RCRA hazardous wastes, Series "B" for California, non-RCRA wastes, and Series "C" for directly recyclable or large-volume, low-hazard wastes. A Series "A" permit is very similar to the Federal RCRA permit, and most resource recovery facilities of that type already have Federal RCRA permits. Series "B" and "C" permit regulations lessen some of the permit application and processing stipulations consistent with the degree of hazard posed by the waste handled. This is intended to cut permit processing time and lessen the paperwork load for facility operators.

The designation "resource recovery facility" is intended to reduce the stigma imposed by the title "hazardous waste facility" by differentiating those facilities that recycle wastes from those that ultimately dispose of hazardous waste. The objective is to make the siting of recycling facilities less of a problem.

D. Local Government Regulatory Requirements

In California, regulation of hazardous waste is also found at the county level. In at least two counties, Santa Cruz and Sacramento, generators may be required to employ special consultants or inspectors to conduct environmental audits if deemed necessary by the county. In Santa Cruz County, the consultants must demonstrate expertise to the satisfaction of the county. Their report must include an evaluation of the facility and recommendations to the generator on how to comply with county regulations. Within 30 days of issuing the report, the generator must file with the county a plan for implementation of the recommendations or an explanation of why the recommendations will not be implemented.

III. Fee and Tax Incentives

Under the Hazardous Waste Control Act, California imposes fees on hazardous waste disposal according to the type of waste being handled. Prior to July 1, 1985, specified charges were levied on each ton of hazardous waste. These charges varied according to whether the waste was hazardous, extremely hazardous, restricted, etc., under the State's classification. Legislation passed during the 1985 session has replaced these specified charges with a fee schedule anchored to a base rate formula. Using the formula, the fees will depend upon the amount of waste produced in the State. The formula is designed such that fees per ton generated will increase as total tons generated fall. Revenues from the fees are collected in an amount sufficient to cover the costs of administering the fee program plus a 5 percent operating margin.

Recent legislation has also shifted the burden of payment of these fees from disposal facilities to hazardous waste generators. Disposal facilities are responsible for paying fees only on their disposal of waste received from out-of-State generators.

In addition to the hazardous waste control fees, generators are required to pay taxes under the Hazardous Substances Account Act. The revenues from these taxes revert to the Hazardous Substances Account, which is a site cleanup fund. These "Superfund" taxes are based upon a formula much like the one for the generator fees. The base rate for the tax is inversely related to the estimated number of tons produced in the State.

IV. Loan and Bond Assistance

A. Pollution Control Financing

Assistance with pollution control financing is available through the California Pollution Control Financing Authority. The assistance is provided in the form of tax-exempt bond financing for the purchase of pollution equipment. The program features:

- No limit on the amount of tax-exempt bond financing available; and
- Exemption from the State interest rate ceiling on industrial development bonds.

According to the Authority, annual interest rates on these bonds are 2 percent to 5 percent lower than rates on funds from conventional sources, so that the cost of borrowing capital to pay for pollution equipment is lower. The payback period is also longer. Interest earned by the bond purchaser is exempt from taxation. A key point of project eligibility for a bond issue is the Internal Revenue Service requirement that pollution abatement facilities produce no material profit or productivity increase for the operator, and that resource recovery facilities yield useful forms of material or energy as a means of waste disposal alone.

B. The Hazardous Waste Reduction Incentives Account

The Hazardous Waste Reduction Incentives Account is currently funded at $5,200,000 of which $2,600,000 is allotted to the California Pollution Control Financing Authority. With this money, the Authority is permitted to contract with financial institutions in support of the granting of credit to medium and small generators for the purchase of waste-reducing equipment. The impetus for the legislation establishing the account originated with the observation that medium and small generators have had difficulty obtaining such financing because of their poor credit and/or the high costs associated with obtaining loans. The Authority can lower these costs by using the account to support interest rates and/or directly pay loan costs. It may also use the account to cover its own costs from the issuance of revenue bonds.

V. Grant Programs

The State of California provides funds for research and development by private consultants and hazardous waste generators. A current example of work by consultants is a study of the economic incentives to reduce hazardous waste (ICF 1985). Recent legislation has set aside funds to support research and development by the public, private, and academic sectors, and to enable technology demonstrations by cities, counties, and private firms.

With the Hazardous Waste Reduction, Recycling, and Treatment Research and Demonstration Act of 1985 (Assembly Bill 685), a grant program was established within the Department of Health Services to disburse funds for the research, development, and commercial demonstration of reduction, recycling, and treatment technologies. The Act established two separate fund accounts, one for providing research and development support to universities, governmental agencies, and private organizations, and the other to facilitate technology demonstrations by cities, counties, and private firms. For the demonstration project grants, one of the following criteria must be met:

- The project must have onsite as well as offsite potential for reduction, recycling, or treatment of hazardous wastes;
- The project must have the potential to benefit, or be used by, small businesses; or
- The project must be potentially applicable to a range of industries.

Examples of reports put out or sponsored by State offices follow in Section VIII.

VI. Information Programs

A. The Waste Reduction Program

The Alternative Technology and Policy Department Section of the DHS's Toxic Substance Control Division has outlined a program for the promotion of waste reduction. The program, a responsibility of the Waste Reduction Unit, features several approaches to the problem including technical assistance, information transfer, regulatory measures, and economic incentives. Technical assistance would include joint studies with industry associations of waste reduction possibilities for large generators, studies of specific waste streams, and waste reduction audits for small businesses. The plans for information transfer include the development of regulatory fact sheets, of appropriate technology, and of financial incentives as well as the use of seminars, biennial alternative technology reports, the California Waste Exchange newsletter, and a technical reference center. The regulatory program includes the California land disposal ban (which can be suspended for certain wastes if capacities for alternative means of disposal do not exist), in addition to the economic incentives, both in place and planned, are grants and appropriations as positive incentives for waste reduction activity, and generator fees and Superfund taxes as disincentives to waste generation.

B. The California Waste Exchange

The California Waste Exchange is operated by the Resource Recovery Unit of the Department of Health Services' Alternative Technology and Policy Development Section. The program has been operating for approximately five years and currently has three staff members.

To facilitate the exchange of wastes among generators, a newsletter is issued quarterly containing listings on available or desired wastes. The listings are coded and include information on waste type, concentrations, quantity, and the geographic location of available or desired wastes. In addition, there are reports on changes in State and Federal hazardous waste laws, regulations, and procedures.

The program also puts out a Directory of Industry Recylcers, which gives the names and locations of recycling companies and the types of materials they recycle. The listings are compiled from information obtained by questionnaires, field reports, and telephone contacts. Only those facilities with a California hazardous waste facility permit or with interim status documentation are listed. The Directory is updated as appropriate.

VII. Award Programs

California currently has award programs to encourage minimization.

VIII. Publications and References

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APPENDIX J.2

GEORGIA

J.2 Georgia

Georgia's major effort to promote waste minimization is the Hazardous Waste Onsite Consultation Program, a nonregulatory technical assistance program. Proceeds from revenue bonds may also serve as incentives for recycling and source reduction.

I. Legislative Background

The Georgia Hazardous Waste Management Act, adopted in 1979, established the administration and enforcement procedures applying to the State's hazardous waste regulatory effort. It authorized the Environmental Protection Division (EPD) of the Georgia Department of Natural Resources as the lead agency in hazardous waste regulation and set penalty fees for noncompliance at a maximum $25,000 per day.

In 1981, the Georgia Hazardous Waste Management Authority Act created a State Authority with the power to plan, construct, and operate/manage hazardous waste facilities. The Authority was also empowered to charge fees for the use of facilities under its operation.

II. Regulatory Programs

Hazardous waste rules in Georgia are the same as the Federal rules. The State rules appear under Title 391, Natural Resources, Article 3, Environmental Protection, Chapter 11, Hazardous Waste Management, where the Federal regulations are directly cited.

III. Fee and Tax Incentives

Georgia currently uses no fee or tax incentive to encourage waste minimization.

IV. Loan and Bond Assistance

Proceeds from Georgia's general obligation revenue bonds may be used to pay for project costs related to hazardous waste recycling and source reduction.

V. Grant Programs

Grants are available to cities and counties for solid waste management endeavors, which may include resource recovery from hazardous waste (personal communication with John Taylor, Georgia DNR, February 13, 1986). Thus far, Georgia has not awarded grant monies to hazardous waste generators or other organizations for research, development, or demonstrations of waste minimization technologies.

VI. Information Programs

A. Hazardous Waste Education/Information Program

In June 1984, the EPD began a hazardous waste education program to increase the public's awareness of existing sources and management options for hazardous waste. The program promotes the concept of management of hazardous waste alternatives to land disposal, e.g., hazardous waste reduction, treatment, and recycling.

The program has three major components: (1) public meetings and workshops, (2) media information coverage, and (3) school support. The most intensive component is comprised of public meetings, speeches, and workshops. Workshops for citizens and breakfast meetings for opinion leaders have been held in 18 cities throughout Georgia. Concurrent with the workshops, the EPD has made presentations to civic and professional groups, and numerous radio and TV appearances. A major goal of the program is to inform the public on hazardous waste issues and solutions and to encourage them to take an active role in the decision-making process.

B. The Hazardous Waste Onsite Consultation Program

The Hazardous Waste Onsite Consultation Program (OSCP) is a pilot program conducted by the Georgia Tech Research Institute's Environmental Health and Safety Division. It is jointly funded by the Georgia Environmental Protection Division (EPD) and the U.S. EPA, and was established in mid-1983 to determine whether such a program could significantly aid the expanding community of regulated waste generators in voluntarily complying with hazardous waste regulations. Georgia's small- and medium-size businesses are expected to derive the greatest benefit from the program.

The actual onsite evaluation involves several steps. OSCP is supplied with preliminary information, and a visit to the facility is scheduled. The OSCP auditor and a company representative then go over regulations and company processes before touring the facility site. The auditor and representative discuss the auditor's observations, and the auditor preliminarily assesses the facility's regulatory compliance status. After the first visit, the auditor submits a confidential report containing his identification and characterization of the waste streams, results of any laboratory analysis, his final assessment of the facility's regulatory compliance, and his recommendations to correct or improve any problems. A follow-up visit is scheduled for sometime during the next year.

Assistance is also provided to firms in meeting reporting and pretransport requirements and in preparing manifests. Additionally, program personnel can review treatment, storage, and disposal alternatives and can provide guidance concerning the financial requirements of complying with the regulations. No engineering or analytical services are supported, and assistance is expected to be short-term. The program is publicized in the media and through the regional offices of Georgia Tech. As part of its educational function, the program conducts seminars, workshops, and short courses.

VII. Award Programs

Both the Business Council of Georgia and the Georgia Department of Community Affairs sponsor award programs that may encourage hazardous waste recycling and source reduction. Each year, the Georgia Environmental Protection Division nominates companies that have shown outstanding improvement in the areas of air quality, water quality, and/or hazardous waste management to the

Business Council. The annual award given by the Georgia Department of Community Affairs is for achievement in resource recovery (personal communication with John Taylor, Georgia EPD, February 13, 1986).

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APPENDIX J.3

ILLINOIS

J.3 Illinois

Illinois has attempted to minimize hazardous waste generation through the regulatory strategies, fee incentives, loan and bond assistance, research and information programs, as well as a waste exchange. The Illinois Environmental Protection Agency, the Development Finance Authority, the Hazardous Waste Research and Information Center, and the Industrial Materials Exchange Service are just some of the organizations involved with waste minimization in Illinois.

I. Legislative Background

Waste control in Illinois began in 1970 with the Environmental Protection Act, which created the Illinois Environmental Protection Agency (IEPA) and statutes addressing the pollution problem. In the mid-1970s, the Act was amended to include provisions on hazardous waste as the IEPA turned towards the regulation of waste from industrial sources. Restrictions on the location of hazardous waste disposal sites were added in 1979, as were provisions for long-term care of sites, for the financial responsibility of owners, and for the establishment of a hazardous waste fund financed through fees on hazardous waste disposal.

In 1981, the Environmental Protection Act was again amended, this time to authorize a State regulatory program paralleling the Federal program. Also in 1981, the General Assembly passed a bill banning land disposal of all liquid hazardous wastes beginning January 1, 1987. In 1983, this schedule was accelerated to prohibit landfill disposal of all liquid hazardous wastes after July 1, 1984, unless no technically and economically feasible alternative existed.

Further revisions to the Environmental Protection Act in 1983 included an increase in disposal and treatment fees and the requirement for an annual hazardous waste report by regulated facilities. The Act was amended again in 1984 to list certain dioxins as hazardous waste, to establish fees on waste handling, and to direct the Department of Energy and Natural Resources to study the underground injection of hazardous waste.

The State of Illinois has also launched the Chemical Safety Research Initiative, which calls for toxicity testing of common chemicals and for State government assistance to industries, communities, and local governments in coping with hazardous waste problems.

An Illinois State Law, effective January 1, 1987, will require that recycling be considered as a waste management practice prior to land disposal (Ferguson 1985).

II. Regulatory Programs

A. Land Disposal Ban

The Illinois Administrative Code (Title 35-Environmental Protection, Subtitle G-Waste Disposal, Subchapter C: Hazardous Waste Operating Requirements, Part 729) stipulates that landfilling of certain wastes is prohibited. At this time, the code prohibits the landfilling of all liquid hazardous wastes, of halogenated organic solvents in nonaqueous liquid phase, and of solids containing halogenated organics which, when combined with water, would form a liquid having concentrations in excess of the specified minimum. To determine whether a waste is a liquid, the State of Illinois uses not only the Federal paint filter test, but also its own penetrometer test.

The land disposal ban on halogenated organics and liquid hazardous wastes went into effect in July 1, 1984. Sludges and still bottoms resulting from the recycling of halogenated organic solvents are excluded from the ban.

B. Special Generic Permits

Illinois has three classes of permits: (1) individual waste stream, (2) development and/or construction, and (3) operating. Operators are usually required to obtain permits for each waste stream in addition to their operating permit. The Illinois EPA has developed a generic permit for operators, which allows operators to receive more than one waste stream under a single permit. The generic permit was created to expedite the facility permitting process.

III. Fee and Tax Incentives

The State of Illinois levies waste-end fees on hazardous waste which vary according to the method of waste management employed. The fee structure is as follows (Illinois Environmental Protection Act Sec. 22.2):

Waste going to treatment	\$0.01/gal or \$2.02/cu. yd. (\$10,000/yr. max.)
Land disposal	\$0.03/gal. or \$6.06/cu. yd. (\$10,000/yr. max.)
Underground injection	\$2,000/yr. for less than 10 million gals./yr.
	\$5,000/yr. for between 10 and 50 million gals./yr.
	\$9,000/yr. for more than 50 million gals./yr.

IV. Loan and Bond Assistance

The Illinois Development Finance Authority (IDFA) conducts an environmental control financing program for small businesses as defined by the Small Business Administration. According to that definition, a business is small if, together with all affiliates, it has:

a. A maximum net worth of \$6,000,000 and an average net income of \$2,000,000 in the preceding two years, or

b. A maximum of 250 employees, though this number is the general maximum with many specific industries (by SIC code) having larger limits.

The IDFA provides financing through issuance of environmental control revenue bonds. The interest on these bonds is exempt from Federal income taxation. Proceeds from bond sales are loaned to successful applicants for construction and/or acquisition of environmental control facilities.

The State of Illinois does not guarantee repayment of bond obligations, but acts solely to secure the tax exemption on the interest. Repayment terms, interest rates, and other particulars of the financing are negotiated among the IDFAs, the small business applicant, and the bond purchaser.

V. Grant Programs

Illinois awards research grants through the Hazardous Waste Research and Information Center (see discussion under VI.A).

VI. Information Programs

A. The Hazardous Waste Research and Information Center

The Illinois Hazardous Waste Research and Information Center was created by the Chemical Safety Research Initiative of 1983, which arose out of public concern over hazardous waste disposal. The center has three programs: (1) research, (2) technical information and information/data management, and (3) industrial and technical assistance. Initial funds and activities have thus far focused on the research program, which is staffed by a program coordinator, a research scientist, and a collaborating scientist in each of three surveys (Natural History, Geological, Water, and State Museum) within the Illinois Department of Energy and Natural Resources. This group is investigating several alternative technologies to hazardous waste disposal.

The Center began operation in June 1984 but was not fully staffed until the summer of 1985. The Center has a director and is supported by an administrative staff consisting of an executive secretary and a financial affairs officer. Additional administrative support is received from Water Survey Office personnel.

For fiscal year 1985, the Center received $800,000 outright from the Illinois legislature, another $200,000 from utility tax revenues, and $300,000 from hazardous and solid waste disposal fees, for a total funding of $1.3 million. The level of funding has remained approximately the same for fiscal year 1986.

In fiscal year 1985, research grants administered by the Center totalled approximately $500,000. Research is promoted in four areas: (1) characterization and assessment of hazardous waste; (2) environmental processes; (3) source reduction; and (4) treatment and remediation. Most of the initial research work has been on characterizing waste streams and assessing the quantity of waste generated. Research projects for fiscal year 1986 contain further work in this area and also include several studies of environmental processes and a study on waste cleanup. The results of these studies will have some bearing on future grant programs.

A hazardous materials laboratory is planned for the near future. It is expected to be a state-of-the-art facility for research and pilot studies of hazardous wastes. The lab is projected to cost approximately $8,000,000 to 10,000,000, and $200,000 has already been committed to the effort.

The research budget for fiscal year 1987 is anticipated to contain $100,000 for matching grants to aid firms in studying the feasibility of waste reduction measures. To fund its future research projects, the Center hopes eventually to obtain funding from sources outside the State government.

B. The Industrial Materials Exchange Service

The Industrial Materials Exchange Service (IMES) completed four years of operation as a passive waste exchange in April 1985. This waste exchange, sponsored by the Illinois EPA and the Illinois State Chamber of Commerce, is being cooperatively distributed through eight State and private sector agencies, including the Illinois EPA (IMES 1985). Funding is by State government appropriations and is currently at a level of approximately $300,000 per year.

In addition to its passive waste exchange operation, IMES conducted a pilot study to actively identify possible waste exchanges. Thirty leads of potentially recyclable waste streams were identified. Of those leads, one firm was already applying for a permit to transfer the waste stream identified to the same company that had been identified by the IMES staff; seven firms had waste streams that were not reuseable, had insufficient quantities or concentrations, or were no longer available. The remaining 22 firms were interested in following up on the potential exchange (IMES 1985).

Over four years of operation, IMES reports that it has helped industry realize costs benefits of $2.57 million while reusing and recycling approximately 12 million gallons of waste. For the 1984 calendar year, industry profited over $1.21 million by transferring over 900,000 gallons of waste through the IMES. A successful exchange rate of 20 percent was estimated for 1984, the IMES believes that the actual rate was higher (IMES 1985).

VII. Award Programs

Illinois presently has no award program that directly promotes hazardous waste minimization.

VIII. Publications and References

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APPENDIX J.4

MASSACHUSETTS

J.4 Massachusetts

Massachusetts has recognized the importance of minimizing hazardous waste and is taking steps to develop a comprehensive source reduction program in the Commonwealth. After lengthy analysis of the topic, the State has determined that an effective program must be integrated with other State programs influencing hazardous substance management. The State points to industry case studies that show how far reaching source reduction efforts can minimize the use and release of hazardous substances. Source reduction program development in Massachusetts focuses on input substitution and plant-wide process improvements. Program components may include coordination of regulatory programs in air, water, hazardous waste, and right-to-know; improvements in reporting requirements to enable better planning of source reduction efforts; and education and outreach programs, which include technical and economic assistance.

I. Legislative Background

Massachusetts legislation that involves hazardous substance management consists of (1) the Massachusetts Hazardous Waste Management Act of 1979 (Chapter 21C), which establishes the authority for development of a hazardous waste management program; (2) the Massachusetts Hazardous Waste Facility Siting Act of 1980 (Chapter 21D), which prescribes a process for siting new hazardous waste management facilities; (3) the regulations pursuant to the Clean Air Act (310 Code of Massachusetts Regulations (CMR Section 6-8); (4) the regulations pursuant to the Clean Water Act (314 CMR 1-9); (5) the Right-to-Know law (Chapter 11F; 105 CMR 670, 310 CMR 33, 441 CMR 21); and (6) the Massachusetts Oil and Hazardous Materials Release Prevention and Response Act of 1983 (Chapter 21E), which establishes a $75 million fund for State cleanup of uncontrolled waste disposal sites to be paid for by a transporter fee.

Implementation of these laws is carried out by two State agencies: the Department of Environmental Quality Engineering (DEQE) and the Department of Environmental Management (DEM), as well as by the Hazardous Waste Facility Site

Safety Council (HWFSSC). Overseeing DEM and DEQE is the Executive Office of Environmental Affairs (EOEA). The Secretary of Environmental Affairs is in a position analogous to that of the U.S. Secretary of the Interior. He has indicated that the foundation of a hazardous waste management plan should include, among other things:

- Development and enforcement of strict hazardous waste management regulations;
- Reduction of the quantity of hazardous waste generated;
- Establishment of safe and well-managed treatment, storage, and disposal facilities; and
- Establishment of public participation and education programs regarding hazardous waste issues (Mass. DEM, p. 1-1).

The Massachusetts Hazardous Waste Management Act of 1979 (Chapter 21C), implemented by DEQE, is the act by which Massachusetts has taken primary responsibility for administration of RCRA. DEQE has undertaken its responsibility for the hazardous waste program in two phases. Phase I regulations, effective as of July 1982, cover the management and administration of notification, manifests, recordkeeping, and reporting for generators. The Phase II components, promulgated in October 1983, essentially parallel RCRA Part B requirements.

In the FY 86 statutory budget, the Bureau of Solid Waste Disposal and its Source Reduction Program were relocated from the Department of Environmental Management (DEM) to the Department of Environmental Quality Engineering (DEQE). In the fall of 1985, the Secretary of Environmental Affairs designated DEQE as the lead agency to develop programs, plans, and policy for source reduction. The Bureau of Solid Waste Disposal has continued to carry out substantial research and planning activities to develop a comprehensive source reduction program for Massachusetts, and will integrate these activities with DEQE's regulatory programs in air, water, hazardous waste, and right-to-know, as well as other agencies where appropriate. The Secretary of Environmental Affairs has stated that source reduction activities, for the purpose of hazardous waste generation and facilities needs data, as they relate to siting responsibilities, should remain at DEM, operating in consultation with DEQE (personal communication with Richard Bird, Massachusetts DEQE, February 13, 1986).

The attention of the Department of Environmental Management (DEM) is focused on a variety of hazardous waste issues, including public participation and the siting of TSD facilities, household hazardous waste, an autobody shop recycling program, and a coalitions program, which offers small grants to regional groups for a variety of efforts. The Hazardous Waste Facility Site Safety Council is responsible for implementation of the Siting Act with DEM (personal communication with Pat Lebau, Massachusetts HWFSSC, February 13, 1986).

II. Regulatory Programs

The Massachusetts source reduction program does not consider recycling as part of its program unless the recycling is an integral part of a manufacturing unit. Nevertheless, the State has put substantial effort into creating a fair and effective recycling regulatory program.

As of 1983, DEQE developed guidelines to encourage recycling. Hazardous wastes that were reused, reclaimed, or burned as fuel were not subject to State regulations regarding transportation and TSD facility licensing. Before a company was eligible for regulatory relief, an application had to be filed with and approved by DEQE. Compliance with terms and conditions stipulating operation was necessary for approval of a request. The recycling permit was viewed by firms as very restrictive, however, since only 12 permits were issued between 1983 and January 1, 1986.

DEQE must now develop regulations consistent with those that EPA promulgated January 4, 1985, i.e., the revised definition of solid waste (see Appendix F for further details on these regulations). The new RCRA regulations now include some wastes as hazardous and solid wastes even if recycled. Although the actual act of recycling is not regulated under Federal regulations, shipping these wastes offsite to be recycled requires manifesting. Those wastes that are excluded from the definition of solid waste under RCRA are exempt from the manifesting requirement at the Federal level. Under Massachusetts laws, the actual act of recycling is regulated. The exemptions from the Federal manifesting requirement for wastes that are excluded from the definition of solid waste are also exempted from Massachusetts' manifesting requirements.

The new DEQE recycling regulations, based on those promulgated January 4, 1985 by EPA and now in draft form in Massachusetts, are expected to encourage recycling upon their implementation. There are, however, no source reduction regulatory requirements now in place other than the RCRA II mandated certification requirements (personal communication with Karl Eklund, Massachusetts DEQE, February 13, 1986).

Under the new recycling regulations, DEQE is proposing that there be a new category for hazardous waste to be known as regulated recyclable material. Operators who wish to function under the new regulations must do so under recycling permits that are less restrictive than either the recycling permit or the TSD permit now required. Failure to comply with the conditions of the new permit will, however, result in a company's being required to go through the full TSDF permit process.

There will be three classes of permits, each with increasingly stringent requirements for compliance. The categories of permit are based on substance and process.

The Class A permit is the least restrictive and covers substances that EPA categorically exempts from TSD requirements. The application for a permit basically will inform the State that recycling is taking place. Requirements will be few and conditions broad.

Class B permits will apply to wastes delineated as less hazardous in the EPA recycling regulations. Categories of waste included are:

- Use constitutes disposal;
- Burning for energy recovery;
- Used oil recycled in any way;
- Wastes that contain precious metals; and
- Spent lead acid storage batteries.

Class C is the third and most restrictive regulatory category. Wastes requiring Class C permits are also designated in the EPA recycling regulations. Though this group is subject to regulations that resemble those of a TSD facility more closely than either A or B, recycling will still be encouraged. The generator will be able to recycle onsite, where previously the only viable choice was to have the material hauled offsite for disposal.

The Massachusetts recycling regulations will be presented for public comment in February 1986, and DEQE expects promulgation on or before July 1, 1986. Implementation of these regulations will allow businesses to tailor management standards to encourage recycling (personal communication with Karl Eklund, Massachusetts DEQE, February 13, 1986). RCRA regulations require hazardous waste transporters to be licensed just as TSD facilities must be licensed under RCRA, and limit the landfilling of hazardous wastes. They also prohibit landfilling over "actual, planned or potential" underground drinking water sources, and landfilling is only acceptable when a waste cannot be further treated, recycled, destroyed, or disposed of by other means. Massachusetts regulations, however, do not yet speak to these issues (personal communication, Massachusetts DEQE, February 13, 1986).

In addition to licensing regulations, DEM and the HWFSSC implement regulations that establish siting procedures for hazardous waste facilities. The goal of this procedure is to ensure that all concerned parties understand their function in the process. The HWFSSC plays the following roles:

- Oversees the operation of the siting process;
- Ensures fairness for communities and developers;
- Makes the majority of major substantive decisions in the siting process;
- Reviews notices of intent to determine feasibility; and
- Awards technical assistance grant money to communities participating in the siting process.

This system has been used in the State's attempts to attract private sector developers for hazardous waste treatment facilities. So far, five proposals have been received, but none has been accepted. Public resistance has been a major factor, as has the fact that the objectives of the developer have in most cases not matched those of the State (personal communication with Pat Lebau, HWFSSC, December 19, 1985).

Finally, regulatory activities considered more specific and important to the development of the Massachusetts source reduction program include the effort to coordinate those existing regulations that influence the management of hazardous substances at the industry level. The State's objective is to integrate the activities of these programs so that source reduction is encouraged wherever possible, and to develop new regulatory systems, especially in the area of reporting requirements, to more directly facilitate source reduction efforts in industry (personal communication with Richard Bird, Massachusetts DEQE, February 13, 1986).

III. Fee and Tax Incentives

Massachusetts has carried out preliminary reviews of revenue generation systems and has considered their potential to serve as direct incentives for waste minimization. The State will investigate revenue generation systems more extensively in the near future and considers them a necessary component of an effective source reduction program. A stable revenue generation system would be used primarily to fund targeted and substantial incentive programs to assist industry with source reduction efforts.

The State has concluded that in some situations taxes or fees will serve only as indirect incentives for source reduction, since the costs of waste management and liability insurance are fluctuating so rapidly. These fluctuations will, in most cases, offset the effect of such taxes or fees, which would be minor in comparison. The State believes waste-end fees or taxes may serve in certain instances as disincentives to the RCRA waste generation reporting requirements, which are still in the early stages of development and reliability. As an alternative, the State is investigating a tax or fee system on hazardous inputs and intermediates, believing that such a system may serve as a more reliable means of raising revenue for source reduction. A tax or fee on inputs may simultaneously encourage some firms to consider source reduction input substitution and process changes to avoid the increased costs of both hazardous inputs and the release of these constituents to the environment at large (personal communication with Richard Bird, Massachusetts DEQE, February 13, 1986).

One fee structure under consideration may have some effect on waste management. Under Chapter 21E (this is the State version of Superfund), DEQE is in the process of implementing a transporter fee designed to help recover some of the costs associated with State cleanups. This fee will be, in effect, a waste-end tax. Onsite waste management appears to be increasing in part in anticipation of this fee, according to discussions with DEQE and DEM personnel (personal communication with Richard Bird and Lee Dane, February 13, 1986).

IV. Loan and Bond Assistance

Massachusetts legislators have filed several bills calling for loans and bonds to facilitate waste minimization practices. Although the concept of source reduction has earned strong support among lawmakers, the consensus has been that more analysis is needed before such economic incentives are established. The analysis necessary for development of an effective source reduction program is nearing completion, and a renewed emphasis on legislation for loan and bond assistance may be included at that time (personal communication with Lee Dane, Massachusetts DEM, December 20, 1985).

The Massachusetts Industrial Finance Authority (MIFA) has been considered a possible source of revenue to enable small generators to install source reduction equipment. No credit assistance program for source reduction has been initiated by MIFA to date, but one is under review at the present time (personal communication with Lee Dane, Massachusetts DEM, and Pat Lebau, HWFSSC, February 13, 1986).

V. Grant Programs

In 1983, DEM made the first grant under their Safe Waste Management Participation Program. This program is composed of local advocacy groups who view hazardous waste issues from a variety of perspectives. The program has funded studies and projects on subjects ranging from underground storage tank management to technical assistance workshops for specific industry segments, and will be expanded further in FY 1987 (personal communication with Anita Flanagan, Massachusetts DEM, February 13, 1986).

VI. Information Programs

A. Information Transfer and Technical Assistance

Distribution of information concerning waste reduction is initiated in two general ways: (1) the Commonwealth offers activities designed to inform concerned parties or (2) inquiries are made to the State by generators. Conferences and seminars have been successful promotional tools in the past, and the information programs have stimulated enough interest to continue the conference/seminar format.

In October 1983, the Bureau of Solid Waste, then part of DEM, held the first Source Reduction Conference and Exhibition with the help of the Source Reduction Advisory Committee. The one-day gathering in Boxborough, Massachusetts, featured 40 exhibitors, 27 speakers, and approximately 350 attendees. Sessions focused on a variety of waste reduction issues including solvent recycling and substitution, waste exchanges and recycling, policy issues, technical assistance, and plant management. The second conference, held in October 1984, grew to nearly twice the size of the first. According to DEM personnel, the proceedings resulting from these conferences have been two of the most effective technology transfer tools to date.

A third general conference is planned for October 1986, in addition to others of a smaller scope. One of the smaller conferences will be geared toward the corporate office and will stress management strategies for source reduction. In addition, industry-specific regional workshops are planned and other substantial outreach projects are under development as part of the comprehensive source reduction programs (personal communication with Lee Dane, Massachusetts DEM, December 20, 1985).

Increased awareness of source reduction/recycling has prompted generators to call the Solid and Hazardous Waste Division Compliance Section with requests for information and questions regarding technical assistance and regulatory compliance. The waste minimization statement now required on the manifest has been a key stimulus to these queries. The Compliance Section personnel are not authorized to refer callers to private corporations specializing in consulting or pollution control devices (personal communication with Linda Benevides, Massachusetts DEQE, July 23, 1985). In the development of a comprehensive source reduction program, however, the Bureau of Solid Waste is considering a substantial technical assistance component, which may include some inquiry response capability (personal communication with Richard Bird, Massachusetts DEQE, February 13, 1986).

B. Source Reduction Program Development

Extensive work is ongoing in source reduction program development in the areas of regulatory improvements, outreach and incentive programs, and revenue generation systems, as discussed above. As part of this effort, the Bureau of Solid Waste Disposal has undertaken three contracted studies to improve the State's ability to develop an effective program.

The first study surveyed specific industries in the Commonwealth to better understand how much waste of particular types is generated and how much source reduction has been achieved. This effort yielded extremely useful case studies and qualitative input from generators on source reduction. Its primary value, however, was to further clarify the definitional problems posed by evaluating source reduction needs or accomplishments on the basis of onsite hazardous waste generation as defined under RCRA. The State has been able to design its source reduction program more precisely, focusing on the quantities of hazardous constituents used and released through various routes from industry processes.

The second study evaluated the business characteristics of four industry sectors in Massachusetts to determine incentive programs for source reduction that would best match their needs. This study has served as a very useful guideline for evaluating more industry sectors in the Commonwealth, and should provide a fairly accurate basis for designing targeted incentive programs.

The third study was a nationwide overview of source reduction program efforts in States and organizations. It has been instrumental in organizing the State's effort to develop a comprehensive source reduction program (personal communication with Richard Bird, Massachusetts DEQE, February 13, 1986).

In addition, targeted economic incentive programs are vital to source reduction program development in the Massachusetts program.

VII. Award Programs

The State of Massachusetts currently has no award programs to promote waste minimization, but is considering such a program as part of its incentive system.

VIII. Publications and References

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APPENDIX J.5

MINNESOTA

J.5 Minnesota

Minnesota has final authorization status to operate its own hazardous waste program under the 1980 RCRA amendments. The Minnesota Pollution Control Agency (MPCA), which enforces environmental regulations, the Waste Management Board (MWMB), and the Minnesota Technical Assistance Program (MnTAP) are involved with various programs that promote recycling and source reduction. These include regulatory programs, fee and tax incentives, loans and bonds, grants, information programs, a technical assistance program, and an award program.

I. Legislative Background

The Minnesota Waste Management Board (MWMB) was formed in 1980 under the Waste Management Act passed by the Minnesota State Legislature. The legislation was enacted in response to a growing concern over pollution associated with the management of hazardous wastes. The Legislature charged the Board with (1) drafting a comprehensive hazardous waste management plan including recommendations and guidelines for the implementation of a sensible and effective waste management policy, (2) selecting "preferred areas" for hazardous waste processing facilities, and (3) locating and developing at least one site for a hazardous waste disposal or long-term storage facility.

In early 1984, the MWMB, in the draft version of its hazardous waste management plan, ranked source reduction and recycling first and second, respectively, as preferred alternatives in the management of hazardous waste. The Board's plan outlined a number of innovative approaches to waste minimization, and the 1984 Legislature consequently adopted three of these recommendations: (1) tax credits for pollution control equipment, (2) grants and loans to support the development of hazardous waste processing facilities and implementation of waste minimization techniques, and (3) the establishment of a technical and research assistance program for Minnesota's hazardous waste generators. In addition, the State adopted an awards program to recognize successes in reducing or improving the management of hazardous waste.

II. Regulatory Programs

Minnesota has two regulatory programs that promote waste minimization. The first, found in the Hazardous Waste Rules, exempts waste that is to be "beneficially used, reused, or legitimately recycled or reclaimed" from Parts 7045.0205 to 7045.1030 (standards applicable to hazardous waste generators) and from most of the MPCA's permitting requirements (Minnesota Rules Part 7045.0125).

The second program is actually a permitting/siting assistance effort by the MWMB, which is a nonregulatory body. To alleviate public concern over facility siting and the regulatory problems associated with obtaining permits and undergoing siting procedures, the Board has selected 21 preferred sites for three types of hazardous waste processing facilities: chemical processing, incineration, and transfer/storage. This action was taken in response to the State's Waste Management Act of 1980, which mandates that at least three sites be chosen for each kind of facility. If a private developer submits a proposal for operating such a facility, especially in a preferred area, and if the proposal is approved by the MPCA, the Board is empowered to mediate disputes between the developer and the local government regarding the siting of the facility. If necessary, the Board can override local objections (personal communication with Wayne Sames, MWMB, January 7, 1986). To date, the Metropolitan Recovery Corporation has obtained approval from a local government to build a facility for the recovery of heavy metals in a preferred area, and has submitted a RCRA Part B permit application to the MPCA.

III. Fee and Tax Incentives

Minnesota's hazardous waste generators are charged a generator fee according to the volume and waste category of waste generated in addition to a 50 percent surcharge on that annual fee. A generator who recovers, reuses, or recycles a hazardous waste stream for his/her own use onsite is exempt from the generator fee for that particular waste stream. Any hazardous sludges or residues from a recovery process, however, are subject to the generator fee (Minnesota Code of Agency Rules Parts 7046.0030 - 7046.0050).

The MPCA reports that the generator fee has worked well as a mechanism to persuade generators to reduce hazardous waste generation, citing as evidence the fact that many generators have switched to alternative waste management practices or have stopped generation altogether. The fee was originally established by the 1983 Legislature not so much as a strategy to reduce waste generation, but to provide funds for ten new staff positions within the MPCA. To generate the legislatively mandated revenues in 1985, MPCA was forced to double the original fee, which has had the effect of placing economic hardship on some businesses. Thus, the hazardous waste generator fee has posed some problems from an administrative point of view. This would probably be the case whenever a budgetary goal is established based on the receipts of such a fee levy (personal communication with Melba Hensel, MPCA, December 13, 1985).

In addition to the fee, hazardous waste generators are taxed based upon the volume and destination of the waste. These "waste-end" taxes, however, do not apply to hazardous "wastes destined for recycling or reuse including waste accumulated, stored, or physically, chemically, or biologically treated before recycling or reuse..." (Minnesota Stat. Sec. 115B.22). Thus, both the fee and tax systems in Minnesota are structured to encourage recycling activities. Waste reduction activities are automatically encouraged by such a system, since the fee and tax levied are a direct function of waste volume.

IV. Loan and Bond Assistance

Loan monies are available for construction of hazardous waste processing facilities, which include both commercial treatment and recycling facilities. Up to 75 percent of capital costs excluding land acquisition may be covered by a facility processing loan (personal communication with Jerry Johnson, MWMB, December 13, 1985). Bonding authority is set by the Legislature at $10,000,000, although other monies may also be available (Minnesota Stat. Sec. 166M.07 Subd. 9).

The program is jointly run by the Minnesota Department of Energy and Economic Development (DEED) and the MWMB. Before a loan application is processed, it goes to DEED for financial feasibility studies and to the MWMB for technical feasibility studies (Minnesota Stat. Sec. 115A.162 and 116M.07, Subd. 9).

Thus far, one firm, Metropolitan Recovery Corporation, is expected to apply for the loan as soon as its permit application is fully approved. The MWMB expects that construction will begin in late 1986. Other companies have made inquiries about available loans; the MWMB believes that the next facility to apply for a loan will most probably be a waste transfer/storage facility (personal communication with Jerry Johnson, MWMB, December 13, 1985).

V. Grant Programs

The MWMB oversees several of Minnesota's grant programs:

- $600,000 for feasibility and development studies of new hazardous waste processing facilities or services;
- $350,000 for the study and development of a Statewide hazardous waste transportation and collection system; and
- $350,000 to study and develop hazardous waste reduction techniques.

Though all three potentially could involve waste minimization efforts as defined in this report, the third, Grants to Minnesota Businesses for Waste Reduction Feasibility Studies, is specifically related to source reduction and recycling.

The third grant program provides a total of $350,000, to be awarded over three years in increments of up to $30,000, for investigating new methods of reducing hazardous waste generation, or for studying the applicability of known waste minimization techniques to a production or handling process. Any hazardous waste generator or group of generators in Minnesota may apply for these grants (personal communication with Wayne Sames, MWMB, January 7, 1986). The program, fully operational since January 1985, is administered by two MWMB staff members, who allocate approximately 50 percent of their time to the project.

The MWMB received few applications for grants in the first grant period because slow progress was made in publicizing the program. Application requests were mailed to 2,500 small waste-generating firms, but just over $100,000 of the fiscal year 1985 allocation of $150,000 was disbursed (a total of 6 grants). A follow-up study of why only six of the 80 firms that requested applications actually submitted applications produced a variety of reasons. The firms cited: (1) the lack of preparation time, (2) the prevalence of other business matters, (3) the narrow eligibility range, and (4) the extensive information requirements as factors weighing most heavily against their participation in the program.

The requirements of the grant program were changed to broaden the range of eligibility and to reduce information demands. The schedule was also revised to allow more lead time than was given in the previous year. The program was first announced in October 1984 and the application deadline fell in early January 1985. For 1985-1986, materials announcing the grant program were available in September and the application deadline was late January. A total of $150,000 was allocated for this year's program. Results of the studies are available to the public (personal communication with Wayne Sames, MWMB, August 23, 1985).

VI. Information Programs - Minnesota Technical Assistance Program (MnTAP)

The Minnesota Technical Assistance Program (MnTAP) is a nonregulatory program that works with hazardous waste generators to reduce hazardous wastes, find cost-effective alternatives to land disposal, and provide regulatory compliance guidance. MnTAP can provide assistance through several mechanisms including:

- Outreach programs, including onsite technical consultations, information seminars, a telephone hotline, and technical workshops and training programs;
- The active assembly, cataloging, and dissemination of information about hazardous waste reduction and waste management methods;

- The evaluation and interpretation of information needed by generators to improve hazardous waste management;
- Information and technical research to identify alternative technical solutions;
- An engineering intern program to implement in-plant changes resulting in waste minimization; and
- Coordination of its efforts with other agencies working towards hazardous waste reduction.

The Legislature specified that the program must focus on assisting smaller generators of hazardous waste, who lack the technical and financial resources to research and implement waste reduction techniques. However, MnTAP also helps manufacturing firms and service companies of any size, industry and trade associations, consultants, and waste management firms.

MnTAP was initially funded at $150,000 for its first year of operation, which officially began in November 1984. Of this, the University of Minnesota received $97,000 to establish the location and operation of the program, including the necessary data base, and the Small Business Development Center received $40,000 to develop information seminars and newsletter articles and to conduct direct mailings of the MnTAP information. The program has been re-funded for the next two years at $200,000 per year. Two professional personnel and one staff assistant currently operate MnTAP.

After one year of operation, MnTAP has gained credibility and recognition through its many services. Initially, slow progress was made in making services known despite a publicity campaign of direct mailings, articles in newspapers, and speaking engagements. The MnTAP staff cited the program's recent formation as the reason for the lack of recognition and established credibility. During its operation, the program has produced information brochures and a series of fact sheets, and has participated in many meetings and conferences to help hazardous waste generators achieve waste minimization. The program operates a telephone hotline that gives free advice and assistance. MnTAP also conducts onsite consultations, which are described as informal plant surveys.

In the summer of 1985, MnTAP sponsored an intern program, in which seven university students (one mechanical, one civil, and five chemical engineers) conducted in-plant surveys/studies of electroplating companies, a painting and coating operation, and a variety of other operations. Interns were able to help participating companies implement practices or operations that have reduced or will result in reducing the quantities of waste being landfilled. In addition, each intern produced a report that documents case studies to be used by MnTAP as examples of methods in which waste minimization can be achieved.

MnTAP hopes to establish a program of research grants to educational institutions in Minnesota this year. These grants, limited in amount to $5,000 each, are intended to support research on new methods to reduce hazardous wastes. A total of $20,000 has been allocated for this year, although MnTAP is investigating the possible availability of Federal EPA grant funds to accelerate this program.

VII. Award Program

Minnesota's award program, the Governor's Award for Outstanding Achievement in Hazardous Waste Management, is a method of recognizing companies or institutions and publicizing their projects. To qualify for the award, a project must achieve one or more of the following: (1) represent a worthy effort at reducing hazardous waste generation, (2) reclaim energy or materials from waste, (3) reduce the quantity of wastes going to treatment and disposal facilities, or (4) reduce the risk of hazardous waste release into the environment. A project is evaluated on the following criteria:

- Environmental benefits;
- Technological importance of its processes or equipment;
- Economic benefits - profits, annual savings, and payback periods; and
- The potential award winner's commitment to sharing information and expertise resulting from the project.

Entries are received in March for awards presented in April. There has been no limit to the number of awards given, although in the future, the number may be limited. Award winners receive a certificate and special flag as a symbol of achievement. Achievements are also publicized in a booklet published by the MWMB (MWMB [1985]). The publicity associated with the award provides an attraction to companies seeking favorable exposure. The program therefore encourages the development of waste minimization among other desirable waste management goals.

In April 1985, seven projects were submitted and seven winners selected. One was further singled out to receive special recognition. The panel of judges felt that all projects demonstrated worthy efforts at hazardous waste management.

The response to the program was considered favorable, especially since 1985 was its first year of operation. Participants expressed some dissatisfaction about the short time limit given for project description. With a few improvements, however, the MWMB hopes to attract greater participation in the coming years (personal communication with Patrick Hirigoyen and Wayne Sames, MWMB, October 1, 1985).

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APPENDIX J.6

NEW JERSEY

J.6 New Jersey

The State of New Jersey has recognized the potential benefits of hazardous waste minimization. The Bureau of Hazardous Waste Planning and Classification and the New Jersey Hazardous Waste Facility Siting Commission are the State agencies addressing minimization with legal authority. Disposal restrictions, permit exemptions, and special allowances for certain industries are examples of regulatory programs that directly or indirectly promote minimization. Seminars, conferences, and a waste exchange have served to educate concerned parties about minimization opportunities, strategies, and techniques. In the future, New Jersey plans to establish a technical assistance program to focus on this issue.

I. Legislative Background

Two laws form the fundamental legal structure for New Jersey's hazardous waste programs: the Solid Waste Management Act of 1970 and the Major Hazardous Waste Facilities Siting Act of 1981. Aspects of waste minimization are part of the responsibility of agencies implementing these laws.

The Division of Waste Management (DWM) of the New Jersey Department of Environmental Protection (NJDEP) is responsible for implementing requirements of the Solid Waste Management Act (personal communication with David Potts, NJDEP, December 12, 1985). The Bureau of Hazardous Waste Planning and Classification within the DWM is the unit whose duties include implementation of both regulatory and nonregulatory programs (with the exception of siting) that affect waste minimization. The Bureau recently sponsored a source reduction seminar held at Rutgers University (August 1985); however, the efforts of this Bureau are currently focused on planning (personal communication with Kevin Gashlin, NJDEP, December 12, 1985).

The Major Hazardous Waste Facilities Siting Act (P.L. 1981, Ch. 279) forms the legal basis for a method of planning, licensing, and siting new hazardous waste facilities in New Jersey. The Act also establishes the Hazardous Waste Facilities Siting Commission, a nine-member group consisting of representatives evenly distributed from industry, county and municipal governments, and citizens groups. Each member is appointed by the Governor.

Assisting the Siting Commission are the Hazardous Waste Advisory Council and the Hazardous Waste Source Reduction and Recycling Task Force. Like the Siting Commission, the Council is composed of representatives from various groups. The Task Force, whose purpose is to encourage education and dissemination of information and also to promote recycling, is composed of representatives from environmental organizations, academia, and industry. As part of its dissemination activities, the group sponsors an annual roundtable. The Task Force is also responsible for advising the Siting Commission on options that it may use for proposed legislation.

II. Regulatory Programs

The State of New Jersey's hazardous waste regulations contain provisions that may directly and indirectly promote waste minimization. Specifically, these provisions are (1) restrictions applied to land disposal, and (2) permit exemptions and special allowances for certain forms of waste recycling.

Landfills are subject to the same requirements as the HSWA of 1984, as well as requirements that go beyond these amendments. For example, New Jersey requires that all landfills must have double liners (New Jersey Admin. Code 7:26-10.8(c)). New Jersey also has regulations requiring that landfills be "constructed such that any leachate formed will flow by gravity into collection sumps from which the leachate will be removed, treated, and/or disposed" (New Jersey Admin. Code 7:26-10.8(d)1.V.).

New Jersey exempts certain specific hazardous waste recycling activities from the requirements of submitting Part A and B permit applications. One exemption related to recycling allows onsite-generated waste to be burned as fuel without the operation's needing a full TSD facility permit. Some of the provisions of this exemption are as follows (New Jersey Admin. Code 7:26-12.1(b)7):

1. Wastes must be burned so that they are "used or reused as a fuel for the purpose of recovering usable energy and are limited to onsite wastes or specific waste between intra-company and intra-State facilities under the control of the same person";

2. A "Permit to Construct, Install or Alter Control Apparatus or Equipment" has been issued by the regulatory agency;

3. Rate of gross heat input must be greater than 20 million Btu/hr;

4. Device must be continuously monitored and recorded for O_2 and either CO or total hydrocarbons;

5. A full-time, certified operator must be present when the waste is burned; and

6. The device must be located in an industrial facility.

Another provision expands the onsite provision to other forms of "recycling" or "reclamation."

Though these exemptions are currently in effect as written, they will soon undergo revision. The new definition of hazardous waste will require that these companies receive an EPA identification number. According to the New Jersey Division of Waste Management, this difference will be slight and its implementation will cause no significant change in the exemption (personal communication with David Potts, NJDEP, January 15, 1986).

The NJDEP, in developing its new definition of solid waste, is planning to incorporate a partial permitting exemption for operations that recycle precious metals and other types of hazardous waste. These businesses would then be allowed to operate with a "Permit-by-Rule" as long as they function within guidelines established by the State. They would not be subject to obtaining a full TSD facility permit. This relaxation of existing regulations will result in encouraging certain forms of recycling (personal communication with David Potts, NJDEP, December 23, 1985).

III. Fee and Tax Incentives

New Jersey presently does not use fee or tax incentives to encourage minimization.

IV. Loan and Bond Assistance

Loan and bond assistance is not available in New Jersey at this time for waste minimization efforts.

V. Grant Programs

The Hazardous Waste Advisement Program has received a grant of $75,000 from EPA to fund a Household Hazardous Waste Project. County governments will receive portions of this grant to execute specific programs. These will include promotion of innovative methods of reducing the need for land disposal of home hazardous waste (personal communication with Kevin Gashlin, NJDEP, December 12, 1985).

VI. Information Programs

New Jersey has several programs and organizations involved in the effort to promote waste minimization by providing informational and technical assistance. Groups involved in this effort include the New Jersey Hazardous Waste Facilities Siting Commission, NJDEP Bureau of Hazardous Waste Planning and Classification, the Hazardous Waste Source Reduction and Recycling Task Force, the Industry/University Cooperative Research Center, the New Jersey League of Women Voters, and the New Jersey Chamber of Commerce.

A. Information Transfer

The Hazardous Waste Source Reduction and Recycling Task Force is a volunteer group, which includes university professors, environmentalists, and industry representatives. The Task Force, with assistance from the Siting Commission, is working on strategies to provide incentives for waste minimization based on the Minnesota and North Carolina programs (see Sections J.5 and J.8 within Appendix J for information on these programs). Presently, the Task Force is involved in a study that will provide information needed to make specific recommendations to the Siting Commission on the incentives and disincentives necessary to achieve the maximum degree of reduction and recycling in New Jersey. Partial funding for this project came from the DEP's Office of Science and Research, and the balance came from the Siting Commission. The scope of this project is to analyze existing source reduction practices and the potential for increased reduction of hazardous waste produced by the following industries: Industrial Inorganic Chemicals (SIC 2819), Plastics Materials and Resins (SIC 2821), Electroplating and Plating (SIC 3471), and Electronic Components and Accessories (SIC 3679) (NJHWFSC 1985).

The Hazardous Waste Advisement Program sponsored the Source Reduction of Hazardous Waste Seminar at Rutgers University on August 22, 1985. Papers were presented on topics that included waste minimization practices and technologies, means of promoting waste minimization, and waste minimization programs. The Hazardous Waste Advisement Program is part of the Bureau of Hazardous Waste Planning and Classification in the Division of Waste Management.

The New Jersey Hazardous Waste Source Reduction and Recycling Roundtable, held on July 25, 1984, was sponsored by the Hazardous Waste Facilities Siting Commission, the New Jersey League of Women Voters, and Shell Oil Company. Topics covered at this roundtable included the Northeast Industrial Waste Exchange, used oil recycling, Minnesota's source reduction and recycling policy, and case studies of waste minimization.

In July 1985, the Task Force and the New Jersey League of Women Voters sponsored a second conference, the New Jersey Technical Assistance Roundtable, in Princeton. Representatives from Minnesota, Pennsylvania, North Carolina, and California each spoke on existing technical assistance programs within their respective States. Presentations were also made by the Hazardous Waste Advisement Program and the Industry/University Cooperative Research Center, which operates out of the New Jersey Institute of Technology. Group discussions at the Roundtable centered on topics such as (1) the need for a technical assistance program in New Jersey, (2) the form of a potential program, (3) the location of program headquarters, (4) staffing, and (5) funding.

The Industry/University Cooperative Research Center is an organization that coordinates the resources and expertise of universities to meet the research needs of participating industrial firms. Presently, the Center is focusing on identifying, evaluating, and developing inexpensive end-of-the-pipe waste treatment and recovery systems, and developing new uses for waste materials. Financial support for the center is generally provided by universities and industrial sponsors. The New Jersey Commission on Science and Technology has also added the Center, and EPA grants have been obtained to support many of the research projects (Liskowitz 1985).

B. Technical Assistance

New Jersey hopes to facilitate waste minimization, specifically in the form of a technical assistance program. The Hazardous Waste Facilities Siting Commission and the DWM are currently drafting a proposal that calls for the following:

- Formation of a task force to oversee the project;
- Study of all technology for hazardous waste impact;
- Review of source reduction and recycling proposals;
- Determination of sources for grants for industry;
- Formulation of regulations to promote the use of innovative and alternative technologies; and
- A survey of existing hazardous waste activities in various industries for the purpose of minimizing the waste of small-quantity generators.

C. The New Jersey State Industrial Waste Exchange

The New Jersey Chamber of Commerce established a waste exchange in 1978 in response to a need expressed by the business community. The service, known as the New Jersey State Industrial Waste Exchange, functions as a passive distributor of information on available or wanted materials. Both hazardous and nonhazardous wastes are included.

Businesses participate by paying a yearly fee; they are included in the listing and receive a year's subscription (3 issues) to its publication. Chamber of Commerce members may list either "Wastes Available" or "Wastes Wanted" for $25.00. Nonmembers may do so for $35.00. Additional items may be listed by members and nonmembers alike for $7.00 per entry. These fees are used to finance this nonprofit exchange. The New Jersey Exchange provides an information transfer service, as opposed to exchanging the waste materials. By assigning each item a code number, the Exchange maintains confidentiality for the participants. When a subscriber sees a potential match between what they and another business want, they contact the Exchange, which, in turn, gives the name of the inquirer to the company that paid for the listing.

The success of this type of waste minimization effort is difficult to assess. The Exchange has received some letters of appreciation, but it is not common for participants to acknowledge the benefits of this service. Occasionally, companies have asked to be removed from the list after incorporating minimization processes into production. Although this is a favorable waste minimization step, it is not necessarily a reflection of the Exchange's success. Demand for the Exchange is strong, however, and it should remain in operation for as long as the need remains. There are about 65 items listed currently. This value fluctuates and at times exceeds 100. Subscriptions usually number between 60 and 78.

There have been attempts to link the New Jersey Exchange to others to increase the potential for exchanges. With the exception of a one-time event with a waste exchange in Pennsylvania, such transfers have not occurred. Although liability problems have forced the closing of some material exchanges, this has not been a problem for the New Jersey Exchange, since they transfer information and do not take physical possession of the materials (personal communication with William Payne of the New Jersey Chamber of Commerce, December 19, 1985).

VII. Award Programs

New Jersey currently does not have an award program to encourage minimization.

VIII. Publications and References

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APPENDIX J.7

NEW YORK

J.7 New York

New York has taken various steps to promote waste minimization through State, regional, and local programs. State programs include: the establishment of the Industrial Materials Recycling Program (IMRP) within the Environmental Facilities Corporation (EFC); Generator Certification Requirements; the Environmental Regulatory Fee System and State Superfund Program; and Land Burial Restrictions. The latter three activities are implemented by the New York Department of Environmental Conservation (DEC). A regional program, centered in New York State, is the Northeast Industrial Waste Exchange (NIWE), an informational waste exchange. Finally, on the local level, Erie County conducts the Industry-Specific Small Quantity Hazardous Waste Generators Technical Assistance Program.

I. Legislative Background

The New York State Governor's Hazardous Waste Treatment Facilities Task Force encouraged the practice of waste minimization by recommending implementation of a four-part waste management hierarchy in the following order: waste reduction; waste recycling, recovery, and reuse; waste treatment or detoxification; and land disposal only for pretreated residuals that have been detoxified so that direct or indirect human contact does not have a significant environmental or health risk. The four-phase hierarchy is implemented by both the New York Department of Environmental Conservation and by the New York Environmental Facilities Corporation.

The DEC was established by the Legislature of the State of New York as the agency responsible for implementing regulations established under the New York State Resource Recovery Policy Act, the New York State Solid Waste Management Plan, the Federal Resource Conservation and Recovery Act of 1976, and amendments thereof. Waste minimization is promoted directly and indirectly by DEC through: (1) the HSWA of 1984 requirement for generator certification of waste minimization on all manifests; (2) the Environmental Regulatory Fee System and State Superfund Fee System; and (3) restrictions on land burial of specific hazardous wastes at all commercial landfills.

The EFC was established under Chapter 744 of the Laws of 1970 as a reconstitution and continuation of the New York State Pure Waters Authority. A nonregulatory agency, it can plan, design, finance, construct, and operate solid waste, hazardous waste, resource recovery and pollution control facilities, and can conduct programs regarding remediation of inactive hazardous waste disposal sites. EFC also finances water management and pollution control facilities through the issuance of industrial revenue bonds. EFC can render advisory services for authorized projects that include wastewater treatment, air pollution control, water management, storm water collection, and solid waste management facilities. EFC has been an active participant in New York State's hazardous waste minimization program since 1977.

In 1981, Chapter 990 amended the Public Authorities Law with the addition of Section 1285-g, which established the Industrial Materials Recycling Program (IMRP). The Industral Material Recycling Act (IMRA), passed by the State, designated EFC as the State entity responsible for implementing the program responsibilities stipulated by law. This law mandates a program to help industry reduce, reuse, recycle, and exchange industrial materials. IMRA is designed to provide industry with direct assistance in the reduction and recycling of industrial and hazardous waste materials as an economically and environmentally sound alternative to disposal.

In addition to the programs supported by New York DEC and EFC, the Northeast Industrial Waste Exchange (NIWE) was established in 1981 to promote waste minimization. This waste exchange is operated by the Central New York Regional Planning and Development Board and the Manufacturers Association of Central New York, and is funded in part by the EFC (see Section 4.3.2 for more information on waste exchanges).

II. Regulatory Programs

The New York Department of Environmental Conservation (DEC) has instituted regulatory programs to implement the four-part waste management hierarchy recommended by the Governor's Hazardous Waste Treatment Facilities Task Force. In addition to the HSWA of 1984 requirement for generator certification on manifests regarding waste minimization, the DEC has placed restrictions on the land disposal of several organic hazardous wastes at commercial land burial facilities in New York State (personal communication with Cliff Van Guilder, NYDEC, November 1985).

The land disposal restrictions were implemented to provide an incentive to use preferred waste management practices. The restricted wastes were selected based on their effect on liners in hazardous waste landfills.

The land burial ban of hazardous organic wastes has the following time schedule and requirements (personal communication with Cliff Van Guilder, NYDEC, November 1985):

1. Twenty-four listed hazardous organic wastes (F001, F002, and 22 K-code wastes) are prohibited from land disposal unless it is demonstrated that the sum total of the "hazardous constituents" is less than or equal to 5 percent of the waste stream by weight. After December 31, 1985 this percentage was reduced to 2 percent.

2. No bulk or containerized hazardous waste may be land disposed that contains in excess of 5 percent by weight as generated, of:

   (a) Halogenated, nitrogenated, or aromatic chemicals;

   (b) Low molecular weight organic chemicals; and

   (c) Any organic constituents identified in 40 CFR 261.33(e) and (f), individually or in combination.

   After March 31, 1986, this percentage will be reduced to 2 percent.

3. The New York DEC may approve the continued disposal of certain waste streams if it can be adequately demonstrated that practical alternative high technology facilities for managing the waste do not exist. This approval is for a maximum of 18 months and may be revoked if an alternative technology becomes available.

4. "Lab Packs" will be regulated according to guidelines established in 40 CFR 265.316, and no lab pack may contain more than one gallon of liquid.

III. Fee and Tax Incentives

The New York State DEC has two fee programs: the Environmental Regulatory Fee System and the State Superfund Fee Program. Both of these programs impose fees on regulated facilities in order to encourage preferred waste management practices. The fees are based on the amount of wastes generated as well as the waste management practice. Under the State Superfund Fee Program, wastes sent to landfills are taxed at the highest rate; wastes sent for treatment are assessed the lowest rate. In addition to the tax on the waste generated, there are also special facility fees assessed on landfills, lagoons, and other units. The fees that the owners pay are thus passed on to the generator shipping the waste to the facility (personal communication with Cliff Van Guilder, NYDEC, November 1985). No fee is imposed on waste that is recycled (GAO 1984). By structuring the fee system in this way, there is an incentive both to generate less waste and to reduce the amount of waste that is land disposed.

New York State did not collect the annual revenues from these waste-end taxes that they expected. In a report prepared by the U.S. GAO (1984), several possible reasons were cited as to why this may have occurred, including: an inaccurate projection; a depressed economy; a loss of out-of-State business at New York disposal facilities; misuse of a materials recovery exemption, which excludes recycled wastes from taxation; and to a lesser extent the underreporting or nonreporting of waste.

IV. Loans and Bonds

In 1974, the Environmental Facilities Corporation (EFC) was authorized to make loans to private industry for air and wastewater pollution control facilities and solid waste management facilities. This authority was extended by Chapter 639 of the Laws of 1978 to include industrial hazardous waste management facilities (which include resource recovery facilities). The loans have no limit and may be for a term of up to 40 years. They may be used to pay (1) the cost of land and appurtenant buildings; (2) equipment and engineering costs; and (3) design, legal, financing, and other related costs. These loans apply to both new and existing facilities, and the loan recipient may also use the accelerated depreciation deductions, investment tax credits, and energy tax credits allowable under State and Federal laws. Since 1976, industry has been issued $123.2 million in bonds under this program (NYSEFC 1985a).

The EFC finances these loans through proceeds of special obligation revenue bonds. Because the interest on the revenue bonds is usually exempt from New York State and Federal income taxes, the EFC can make loans with lower interest rates. The bonds are issued on an individual company basis, so that neither the EFC nor the State of New York is under financial obligation. An additional feature of these loans is that several environmental projects at one or more of a company's plant sites in New York State may be financed through a single bond issue. A company must meet the debt service to demonstrate financial ability to qualify.

V. Grant Programs

Presently, New York does not have a grant program that directly promotes hazardous waste minimization.

VI. Information Programs

A. Environmental Facilities Corporation (EFC)

The Environmental Facilities Corporation (EFC) is a nonregulatory agency formed by the Public Authorities Law of New York State. EFC provides informational, technical, and financial assistance for industrial and hazardous waste management, including waste minimization. Within EFC, the Industrial Materials Recycling Program (IMRP) assists industry in reducing, reusing, recycling, and exchanging industrial materials. This is accomplished through activities such as:

- Technical information and assistance programs;
- Data collection, development, and maintenance; and
- An active waste exchange program.

The IMRP offers technical services to industry by recommending source reduction, energy recovery, and treatment and disposal options. Staff members determine the availability of specific wastes and judge their recovery and reuse potential. Wastes are identified from sources such as the New York State DEC manifest systems, the NIWE Listing Catalog, and EFC staff contacts. EFC's services also include regulatory assistance, technology evaluations, technical feasibility studies, process analyses, research of potential markets for wastes, and assistance in selection of consultants. EFC's services are offered to all companies located in New York State, although small- and medium-size companies are the primary users of this program.

Data collection, development, and maintenance enable IMRP to obtain the information to support its technical assistance programs, as well as information to disseminate to the public. Publications provide a means of transferring technology. IMRP publishes the following:

- Industrial Materials Recycling Act (IMRA) newsletter (published quarterly) covering topics such as waste exchange information, current technical assistance and research programs, and recent papers and publications;
- Hauler's Directory (published annually) based on EFC's survey of permitted haulers;
- Laboratory waste management manual - "A Guide to Informational Sources Related to the Safety and Management of Laboratory Wastes from Secondary Schools"; published as an information source on the proper storage and disposal of small amounts of hazardous wastes; and
- Technical papers written by the staff.

In addition, IMRP has library facilities for over 700 technical materials such as books and reports to aid its staff members in their own research and to provide assistance to industrial clients.

IMRP operates an active waste exchange. The IMRP waste exchange serves as an intermediary between the generator and the potential user, and locates wastes for interested clients.

In addition to IMRA, EFC conducts special projects. This year they have included (1) a Hazardous Waste Management Audit Program for Small Quantity Generators, and (2) a Feasibility Study for a Research and Development Center for Hazardous Waste.

(1) Waste Management Audit Program

In August 1985, EFC was awarded an EPA grant to help small-quantity generators (SQGs) manage industrial wastes. The 20-month program is being developed with the assistance of the Manufacturers Association of Central New York and the Environmental Management Council. EFC selected the Central New York-Syracuse region as a representative industrial region from which data about the types and quantities of waste as well as waste management practices would be collected, analyzed, and incorporated in the development of a State waste management plan for SQGs. The data compiled are expected to highlight the needs of SQGs in the State for reducing, recycling, reusing, collecting, transporting, and treating wastes.

(2) Hazardous Waste Research and Development Center

EFC was appropriated $150,000 in the 1985-1986 State budget to perform a feasibility study for a research and development center for hazardous and industrial waste. It is anticipated that the center will conduct basic and applied research on hazardous waste in the area of source reduction, treatment, resource recovery, recycling, and other forms of waste management, as well as address government and industrial policy issues, disseminate information, and train industrial personnel. EFC contracted with the Rockefeller Institute of Government Affairs to perform the study, which was released in January 1986.

B. Northeast Industrial Waste Exchange (NIWE)

The Northeast Industrial Waste Exchange (NIWE) is an information waste exchange created in June 1981. In the State of New York, the Manufacturers Association of Central New York and the Central New York Regional Planning and Development Board are joint sponsors of the NIWE. The NIWE serves industry throughout the U.S. and Canada. The primary region served by the NIWE includes New York, New Jersey, Pennsylvania, Ohio, Maryland, and the New England States.

As part of the IMRP, EFC began to cosponsor and provide funding for NIWE in 1981; the Ohio Environmental Protection Agency became an additional cosponsor by providing financial support in 1983. In addition to covering printing expenses for NIWE's Listings Catalog, EFC provides NIWE with an informational supplement containing regulatory, technical, waste exchange, legal, financing, and publication information of interest to generators and users (NYSEFC 1985a).

The NIWE exchanges information by listing "Materials Available" and "Materials Wanted" in a quarterly Listings Catalog with a distribution of nearly 9,000. Confidential inquiries received by NIWE are forwarded to the company that placed the listing. The originator of the listing is then responsible for the negotiation. For nonconfidential inquiries, notification is sent to both the originator and inquirer.

NIWE has the first computerized waste listing service in the U.S. This online computer service provides industry with immediate access to listings from the Northeast Industrial Waste Exchange, Industrial Material Exchange Service (Illinois), and Southern Waste Exchange (Florida). NIWE plans to include listings from the Great Lakes Exchange, Canadian Waste Exchange, and Piedmont Waste Exchange. This computerized system makes waste exchange information immediately accessible to a large population of users (see Appendix D for a sample run from this computer system).

C. Erie County, New York - Industry-Specific, Small-Quantity Hazardous Waste Generators Technical Assistance Program

The County of Erie, New York, has a Federal grant to develop, field test, evaluate, and publish guidebooks on the management of small quantities of hazardous waste from specific business categories. This program will be conducted over a two-year period (August 1985 to August 1987) by the Erie County Department of Environmental Planning.

These guidebooks will provide information on the technologies available to each industry for reduction, recycling, reuse, or treatment of hazardous waste. They will also provide information on State and Federal regulations that apply to small quantity generators and the specific industries included in the program. The industries are: vehicle maintenance, metal manufacturing, printing, photography, laundry/dry cleaning, construction, motor freight terminals, and educational and vocational shops. Two more industries (pesticide applicator and general government) may also be included if additional funds are available.

VII. Award Programs

New York presently has no award program that directly promotes hazardous waste minimization.

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APPENDIX J.8

NORTH CAROLINA

J.8 North Carolina

North Carolina has been relatively active in efforts to minimize hazardous waste and other forms of pollution. The lead agency addressing waste minimization is the Pollution Prevention Pays (PPP) Program within the Department of Natural Resources and Community Development (DNRCD). The PPP staff, the Governor's Waste Management Board, the Solid and Hazardous Waste Management Branch of the Department of Human Resources (DHR), the Department of Commerce (DOC), and the Board of Science and Technology work closely together to promote waste minimization, using strategies of information transfer, technical assistance, and grants, as well as a waste exchange and an award program. The State further encourages minimization through special provisions in the tax code for reduction, recovery, and recycling facilities and industrial revenue bonds that are available to finance pollution control facilities.

I. Legislative Background

The North Carolina General Assembly passed the Waste Management Act of 1981 establishing the Governor's Waste Management Board, which had the duty to plan and oversee the safe management of hazardous and low-level radioactive wastes generated within the State. Two of its responsibilities were (1) to promote research and development of new methods to prevent, reduce, recycle, treat, and dispose of wastes, and (2) to evaluate and recommend ways to aid governmental activities concerning waste management. Under the legislative charter, the Board sponsored an award program, the Governor's Award for Excellence in Waste Management. The program was to provide recognition to individuals, companies, and institutes that have shown outstanding commitment, innovation, and/or technological advances through source reduction, recycling, treatment, or other management of hazardous or low-level radioactive wastes.

The official interest of the State of North Carolina in pollution prevention began in 1982 with a Statewide symposium on the question of adopting economical means of reducing pollution as a State policy. This conference was attended by business, government, and academic representatives, who urged the adoption of pollution prevention as the official State approach to waste management. The State responded with Resolution 54 of the 1983 Sessions Laws (Senate Joint Resolution 653), which empowered the State Legislative Research Commission to study the "desirability and feasibility of creating a Pollution Prevention Pays (PPP) Research Center in North Carolina." The Legislative Research Commission appointed the Hazardous Waste Study Commission of 1983 to study the prevention, reduction, treatment, incineration, and recycling alternatives to landfilling disposal as well as the idea of a research center.

The Study Commission adopted a "hierarchy of alternatives" in hazardous waste management and specified the desirable characteristics and objectives for an all-encompassing PPP Program instead of a typical "research center." The alteration of manufacturing operations and the onsite recycling of materials, both of which reduce the overall generation of waste, were recognized as the most preferred waste management strategies. To promote waste minimization, the Study Commission directed that the proposed PPP Program be nonregulatory, yet still operate in conjunction with regulatory and other agencies to meet its goals. The PPP Program was to be involved in research, education, and technical assistance for the benefit of both the general public and the industrial community, particularly those in the industrial sector whose size and resources do not allow independent implementation of pollution prevention methods. The Commission finally recommended that a PPP Program be established within the DNRCD to formally address positive methods of waste reduction.

II. Regulatory Programs

North Carolina's hazardous waste regulations for the most part follow those of the U.S. EPA. There are no special exemptions or modifications for recycling practices other than provisions codified in 40 CFR 266 for recycling materials used in a manner constituting disposal, for hazardous waste burned for energy recovery, and for recyclable materials utilized for precious metal recovery.

The State's land disposal restrictions present some tighter requirements such as additional location standards for hazardous waste management facilities (10 North Carolina Admin. Code 10F .0032(q)) and requirements for landfills. For example, no hazardous waste landfill can be built until at least one "comprehensive hazardous waste treatment facility is fully operational" (10 North Carolina Admin. Code 10F .0032(o)). As the need for establishing a hazardous waste landfill within the State becomes greater, a requirement such as the last may serve as an incentive to building a recycling facility, depending on the interpretation of "comprehensive treatment facility." At this time, no legal definition exists.

III. Fee and Tax Incentives

A. Assessments

Large-quantity hazardous waste generators, transporters, and treatment, storage, and disposal facilities (TSDFs) are all assessed a flat fee according to the following classification (10 North Carolina Admin. Code 10C .0701-.0704):

Generator	$600/year
Transporter	$600/year
Generator and transporter	$900/year
TSDF	$1,200/year
TSDF and generator and/or transporter	$1,200/year

No distinction is made based on volume, toxicity, or type of waste management.

B. Tax Credits

North Carolina law gives special tax treatment to individuals and companies that purchase resource recovery, recycling, and volume reduction equipment or that construct facilities for waste treatment, resource recovery, recycling, and volume reduction equipment. Specifically, the cost of equipment and facilities may be deducted from capital stock, surplus, and individual profits in computing the corporate franchise tax; the cost is eligible for 60-month amortization and is deductible from corporate and individual income taxes (North Carolina Gen. Stat. 105-147). Equipment and facilities for waste treatment, resource recovery, and recycling are also excluded from the property tax base (North Carolina Gen. Stat. 105-275).

Since "resource recovery and recycling equipment" and "resource recovery and recycling facility" are not defined in the statutes, the Department of Human Resources (DHR) is charged with developing and promulgating standards that the equipment and facilities must meet in order to qualify for the tax benefits. Individuals and corporations must obtain certification from the DHR that indicates such equipment and facilities are "exclusively used in the actual waste recycling, reduction, or resource recovery process" and not just in "incidental or supportive" roles (North Carolina Gen. Stat. 130A - 294(a)(3)).

Despite the fact that generators of hazardous waste in North Carolina are purchasing and installing equipment and building facilities for waste treatment, resource recovery, recycling, and volume reduction, few of these taxpayers are taking advantage of the available benefits. Thus far, most of the equipment that has been certified is used for nonhazardous solid waste (Dunn 1985). There is speculation that the program has not been widely used because it is not well known (personal communication with Gary Hunt, PPP Program, DNRCD, December 1985).

IV. Loan and Bond Assistance

North Carolina law authorizes the issuance of industrial revenue bonds to finance a pollution control facility, which includes reduction, recovery, and recycling facilities, if the project meets the approval of the Secretary of the Department of Commerce and the DHR. Such a determination would depend on whether the facility would further the State's waste management goals and not have adverse effects upon public health, the environment, or the economy (Bulanowski 1981, in reference to North Carolina Gen. Stat. 159C-7).

V. Grant Programs

See discussion on Challenge Grants and Research and Education Grants in Section VI.A, Pollution Prevention Pays Program.

VI. Information Programs

A. Pollution Prevention Pays Program

The PPP Program encompasses a number of strategies for waste minimization comprising (1) information transfer, (2) onsite technical assistance, (3) challenge grants, and (4) research and education grants, each being effectively coordinated with the other.

These strategies are discussed below:

(1) Information Transfer

The PPP Program provides information transfer through its Information Clearinghouse and its outreach programs. In the Clearinghouse, an information data base provides quick access to literature sources, contacts, and case studies on waste reduction techniques for specific industries or waste streams. Over 1,200 references on waste reduction methods have been identified and organized by industrial category. Information is also made available through customized computer searches of literature data bases. This provides access to current national and international literature on pollution prevention techniques specific to the problem area.

The Information Clearinghouse also has access to universities, trade associations, industries, research laboratories, and government agencies, which can provide additional technical, economic, or regulatory information. This network includes contacts at State, Federal, and international technical assistance and research organizations. Reports on waste reduction published by PPP staff are available through the Clearinghouse. These include:

- Pollution Prevention Bibliography, which references literature organized by industrial category;
- Accomplishments of North Carolina Industries, which provides case summaries of the technical and economic aspects of pollution reduction efforts undertaken by the State's industries;

- Directory of North Carolina Resource Recovery Firms, which lists companies that purchase waste materials for reuse; and
- A Handbook of Environmental Auditing, which details successful auditing programs used by the State's industries.

Also available through the Clearinghouse are:

- Series of "Pollution Prevention Tips," which provide technical and economic assessments of pollution prevention methods for specific industries such as textiles, electroplating, and furniture manufacturing;
- Handbooks developed in conjunction with PPP's workshops – Managing and Recycling Solvents, Managing and Minimizing Hazardous Waste Metal Sludges, Managing and Recycling Solvents in the Furniture Industry;
- "Challenge Grants Information"; and
- "Information on Research Funds and Projects."

During 1985, the PPP staff responded to an average of 75 phone calls and letter requests each month for general information and literature. Staff also prepared detailed information packages for over 25 industries and communities. These information packages included copies of references, case studies, contacts, and computer literature searches.

As far as the outreach effort, in 1985 PPP staff conducted or cosponsored over 30 presentations on pollution prevention for trade associations, professional organizations, citizen groups, universities, and industrial workshops. They have also sponsored several "Workshops on Implementing State Pollution Prevention Programs," attended by representatives from numerous States, USEPA, and Ontario, Canada.

(2) Onsite Technical Assistance

Comprehensive technical assistance is provided directly through a visit to a facility. During an onsite visit, detailed process and waste stream information is collected and plant personnel are consulted on current management practices. Information is analyzed and a series of waste reduction options for each waste stream is identified. A short report outlining the management options is prepared for the facility. The report package includes all supporting documentation such as literature, contacts, case studies, and vendor information, as well as a preliminary assessment of reduction potential and economics.

In 1985 the PPP staff provided onsite technical assistance to five firms. Onsite visits addressed such waste streams as cooling oils, metal-contaminated wastewater, oily wastewater, acids/bases, metallic sludges, and solvents.

(3) Challenge Grants

The Challenge Grants Project provides matching grant monies in amounts up to $5,000 for projects that evaluate the feasibility of applying methods or technologies to prevent pollution or decrease waste generation. It is aimed at small businesses and manufacturing firms, trade associations, and communities to develop and implement waste minimization techniques for specific waste streams and/or facilities. Projects range from the characterization of waste streams, in order to identify waste minimization techniques, to in-plant pilot scale studies of reduction. Funds are available for the cost of personnel, materials, or consultants needed to undertake a pollution prevention project. Ideally, the lifespan of a project is six months.

Grant proposals are reviewed on the basis of several criteria (PPP Program 1985b):

- Commitment and ability of applicant to implement pollution prevention recommendations;
- Severity of pollution/waste problems or uniqueness of opportunity to prevent or reduce waste;
- Specificity of approach to reduction of waste volumes or toxicity through process modification, waste stream segregation, equipment redesign, recovery for reuse, etc.;
- Potential of implemented recommendations to be economically beneficial to the applicant through payback or cost savings;
- Potential of transfer to other similar waste streams, businesses, or communities;
- Measurable results and proposed project costs; and
- Consultant qualifications.

During the first round in the Spring of 1985, 16 projects were funded, representing over $190,000 in pollution prevention and waste reduction efforts. These projects addressed wastes from such areas as textiles, food processing, hospital laboratories, paper manufacturing, solid waste, waste oil, and drinking water treatment. Waste streams and industries addressed by projects during 1986 include electroplating, waste solvents, laboratory waste, meat packing, seafood processing, textiles, and municipal solid waste. These projects will receive $100,000 in matching funds, doubling 1985's initial allotment of $50,000.

(4) Research and Education Grants

Research and education projects are funded through the North Carolina Board of Science of Technology with staff assistance from the PPP

Program. Grants in amounts up to $30,000 per project per year are made available to sponsoring universities and institutions for research and education addressing the following objectives (North Carolina DNRCD [1985]):

- Target waste streams and industries specific to North Carolina;
- Document economic and technical feasibility of waste reduction techniques;
- Reduce the volumes of the State's major hazardous, toxic, and water/air waste streams; and
- Develop innovative approaches to environmental management.

Research projects range from in-plant demonstration projects to applied research on new technologies. Some of the recent projects include application of pollution prevention techniques to such industries as wood preserving, chemicals, electroplating, textiles, food processing, and microelectronics.

Educational projects include onsite demonstrations and workshops on waste minimization designed for businesses, communities, and citizens. Currently, two projects are being developed for university students: (1) a pollution prevention curriculum for use in engineering and industrial technology programs, and (2) an engineering intern project to place engineering students with industries to develop waste reduction programs for individual firms.

A director's position was first filled in October 1983 to develop the program and recommend a work plan. In January 1984, a business specialist was assigned to provide part-time staff support. Acting on the Hazardous Waste Study Commission's recommendation, the 1984 Summer Session of the General Assembly approved a budget and staffing for the PPP Program, as well as funding for research and education. In January 1985, an environmental engineer and a secretary were added. An additional engineering position has recently been approved by the DNRCD.

The 1985 full session of the General Assembly authorized annual budgets of $190,000 for the PPP Program and $300,000 for research and education for fiscal year 1986 - 1987. Research funds are appropriated to the North Carolina Board of Science and Technology, with staffing provided by the PPP Program. Additional funding of $100,000 annually through 1987 is made through the U.S. Environmental Protection Agency to support research for small business waste reduction.

The initial obstacle encountered in implementing the PPP Program was attaining the visibility and recognition necessary for the promotion of the program's goals and intentions. The designation of the DNRCD as the lead agency in pollution prevention provided a central point of contact and a network of regional DNRCD offices throughout the State. Concurrently, a publicity and information campaign entailing the distribution of PPP literature to trade associations and the insertion of articles in trade association newsletters also helped achieve recognition. In addition, the program began to document successful industry-specific pollution prevention cases and to develop a bibliography and library of source material.

Another early problem was suspicion by industry of technical assistance from what was perceived as a "regulatory agency." North Carolina's PPP Program attributes its success in addressing industry reluctance to (1) developing its own identity through a series of reports and publications, (2) focusing on helping those industries that want assistance, and (3) continually stressing that the Program is nonregulatory in nature.

In its first two years of operation, the PPP Program has concentrated its efforts on information and technology transfer, technical assistance development, and research funding. In the coming year, the program will place emphasis on expanding contacts through technical assistance and onsite consultation. A continuation of research and education projects and Challenge Grant projects will be pursued. An evaluation of these projects will be undertaken to determine if they are meeting objectives and if they can be improved.

Successful technical assistance, onsite visits, and Challenge Grant projects will be compiled into case studies and distributed to respective industries and trade associations. An engineering intern program similar to that of Minnesota's is being developed. Additionally, the program will continue to provide staff support to a "national roundtable" forum of State waste reduction programs and will seek to organize the group more formally.

B. Piedmont Waste Exchange

The Piedmont Waste Exchange (PWE) is an active information exchange sponsored by the Urban Institute and the Department of Civil Engineering at the University of North Carolina at Charlotte. Funding is provided by the Urban Institute, the Governor's Waste Management Board, Mecklenburg County, and various industry and environmental groups and trade associations.

PWD distributes the Waste Watcher, a quarterly bulletin listing companies that want to transfer both hazardous and nonhazardous wastes. The fee for an unlimited number of listings is $40 per year. Approximately 25 percent of the listings receive matches. This waste exchange works with other exchanges, such as the Northeast Industrial Waste Exchange, to increase the potential for successful waste transfers (PWE [1984]).

In addition to arranging waste transfers, PWE prepares and distributes educational literature; makes presentations at industrial meetings, workshops, and conferences; sponsors technical assistance workshops for individual firms; and conducts surveys and studies on hazardous waste topics. Projects conducted by PWE include: a survey of small-quantity hazardous waste generators in Mecklenburg and Gaston Counties; a study of legal, institutional, and policy incentives for waste prevention, exchange, and reuse; and a survey to identify potential waste transfer pairs.

VII. Award Programs

North Carolina has operated an award program for almost four years for the purpose of honoring individuals, companies, and institutions within the State that have demonstrated superior waste management practices for hazardous or low-level radioactive wastes. Each year in the fall, the Governor's Waste Management Board distributes entry forms and information letters on the Governor's Award for Excellence in Waste Management to generators, public organizations, and local governments throughout North Carolina. By December, the entry forms and an accompanying summary of the waste management projects are screened and sent to a five-member judging panel, representing industry, environmental organizations, and the scientific community. The entries are judged in the following categories:

- Commitment by management;
- Creativity;
- Environmental and economic benefits;
- Technological achievement;
- Superior management and engineering; and
- Leadership in communicating technology to others.

Early in the new year, the Governor presents the award winners in each waste category with a plaque and certificate. Annual program costs, including printing, postage, plaques, and publicity, are approximately $3,500 (based on 1983 expenditures).

The award program usually receives 15 to 20 entries each year, although in 1984 only 9 were submitted. The reduced number of participants was ascribed to the lack of media publicity given in the last year and an expanded entry form, which required additional effort to complete. Because of these comments, the Board has decided to increase the publicity by providing more notice to the news media. In addition, the application process has been simplified and the award expanded to further encourage participation, especially by waste management firms and small quantity generators (personal communication with Edgar Miller, North Carolina Governor's Waste Management Board on November 20, 1985).

Recipients of the Governor's Award for Excellence in Waste Management have thus for included: 1982 - Burlington Industries (Furniture Division); 1983 - Stanadyne, Inc. (Moen Division, Sanford Plant) and Duke Power Company (McGuire Nuclear Station); and International Business Machines Corp. (Research Triangle Park). These recipients and the honorable mentions (the number varies from year to year) are listed along with their accomplishments in a booklet that is made available to the general public (Governor's Waste Management Board 1982, 1983, 1984).

VIII. Publications and References

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APPENDIX J.9

PENNSYLVANIA

J.9 Pennsylvania

The Commonwealth of Pennsylvania has combined two strategies in its effort to encourage waste minimization. A licensing exemption is in effect to promote recycling and a technical assistance program disseminates information to facilitate minimization.

I. Legislative Background

In Pennsylvania, the control of hazardous waste is usually provided for within legislation covering solid waste. In 1980, the Pennsylvania Solid Waste Management Act established requirements for accurate recordkeeping, labeling, and manifesting of hazardous waste. In addition, chemical users were required to keep information on chemical constituents and properties and to report on hazardous waste activities and emergency contingency plans. The Act also set down facilities permitting, siting and financial requirements, and prescribed penalties and fines for noncompliance.

II. Regulatory Programs

A. Hazardous Waste Regulations

Hazardous waste regulations in Pennsylvania appear under the Pennsylvania Code, Title 23, Environmental Resources, Chapter 75, Solid Waste Management, Subchapter D, Hazardous Waste. The solid waste regulations, which contain the hazardous waste regulations, were first adopted in 1971, but have been amended through March 8, 1985. The hazardous waste regulations set standards for the identification, listing, transportation, treatment, storage, and disposal of wastes.

B. Licensing Exemption

Under Subsection 75.261 of the State's hazardous waste regulations, generators/transporters who use, reuse, recycle, or reclaim hazardous waste are not subject to the State's transportation license requirement. The exemption does not apply, however, to wastes having commercial value and a history of routine commercial trade. Also, recycling, reuse, or reclamation facilities are required to submit a pre-operation plan describing any proposed chemical mixes to the State Bureau of Air Quality to ensure that air quality standards are met (Pennsylvania Codes Title 25, Chapt. 75D).

III. Fee and Tax Incentives

Pennsylvania offers no fee or tax incentives to promote minimization at this time.

IV. Loan and Bond Assistance

Loan and bond assistance has yet to be incorporated into Pennsylvania's efforts to minimize waste.

V. Grant Programs

Pennsylvania presently does not award grant monies to generators and other organizations as an incentive for waste minimization efforts.

VI. Information Programs

A. Pennsylvania Technical Assistance Program

The Pennsylvania Technical Assistance Program (PENNTAP) is a technology transfer and dissemination service operated by the Pennsylvania State University and the Pennsylvania Department of Commerce under a Commonwealth-University partnership agreement established in 1965. The program employs five full-time technical specialists with backgrounds in engineering and science. These specialists are supported by two technical librarians who maintain PENNTAP's in-house data base. The program is headed by a director, who is assisted by an information coordinator, an office manager, and two other office staff members. Program funding sources include Penn State University's Division of Continuing Education, the State legislature through the State Department of Commerce, and other State and Federal agencies for special projects. Advisory services are provided free of charge.

The bulk of program advisory activity is in microcomputers and computerization (143 cases in 1984), although environmental problems -- those dealing with handling, disposal, and/or identification of hazardous wastes, with solid waste materials, and with other environmental concerns -- comprise a significant portion (62 cases in 1984). Other major areas addressed by PENNTAP include chemical technologies, energy technologies, safety/health (including fire safety), productivity improvements, and construction and maintenance.

According to program literature, PENNTAP required $4.43 million to operate between 1972 and 1984. In that same period, 19,343 problems were addressed, resulting in $79.9 million in benefits to the State's economy. Since 1980, the program has been credited with saving or creating more than 580 jobs. Program impact figures for 1984 alone indicate that 1,242 cases were handled, 59.8 percent of which came from business/industry, entrepreneurs, and consultants/engineers. The economic impact was just under $10.8 million, not including the valuation of 57 jobs created or saved. All reports of economic and job benefits are made by recipients of program services on a post-assistance evaluation form; a 17.8:1 benefit-to-cost ratio has been documented (personal communication with William Arble, PENNTAP, January 31, 1986).

VII. Award Programs

The Commonwealth currently does not use public recognition or honors as incentive to promote minimization.

VIII. Publications and References

Pennsylvania Technical Assistance Program (PENNTAP). 1985. PENNTAP UPDATE 1984. Prepared for the Pennsylvania State University.

(PENNTAP also provides informative pamphlets.)

APPENDIX J.10

TENNESSEE

J.10 Tennessee

The State of Tennessee has recognized the potential benefits of hazardous waste minimization and has addressed the topic through special regulatory requirements for recycled hazardous waste, fee incentives, loan and bond assistance, and a hazardous waste minimization program that is currently doing studies on waste reduction techniques for small businesses.

I. Legislative Background

Tennessee's policies concerning hazardous waste minimization have their legal basis in the Hazardous Waste Management Act. Part I (68-46-101 through 114) was drafted in 1975 and Part II (68-46-201 through 221) in 1983. Of the two parts, the latter is focused more on resource recovery. Modifications to Part II are currently in the process of being adopted by the Tennessee legislature. Among these changes are provisions to: (1) promote efficient and economical management to encourage recycling, (2) prohibit land disposal of certain substances, and (3) subject privately-owned wastewater treatment and pretreatment plants to permits-by-rule.

The Hazardous Waste Management Act is implemented by the Tennessee Department of Health and Environment (DHE). The Division of Solid Waste Management administers Part I, while the Division of Solid Waste Management and the Division of Superfund share responsibility for Part II. The Safe Growth Team, which was previously under the Office of the Governor, is now under the Commissioner of DHE (personal communication with Bobby Morrison, Tennessee DHE, January 30, 1986). Among its objectives, waste reduction and recycling has been adopted as a high priority goal. Initial plans include the establishment of a technical assistance program.

II. Regulatory Programs

Tennessee has special requirements for hazardous waste that is used, reused, recycled, or reclaimed. The requirements allow the generator or other handler to petition to the Commission of the Tennessee Department of Public Health to exclude such wastes from many of the requirements applicable for other hazardous wastes as stated in Tennessee Rules 1200-1-11-.03 through 1200-1-11-.07.

III. Fee and Tax Incentives

The State of Tennessee charges fees for the State's remedial action fund and for permit applications and permit maintenance. The latter are intended to cover the cost of administering the hazardous waste regulatory program. Both application and maintenance fees vary according to whether the application or permit holder is a transporter, a storage facility, a treatment facility, or a disposal facility. For storage and treatment facilities, the fees also vary according to design capacity, with larger facilities paying higher fees. Disposal facilities are assessed a base fee plus an additional fee on the remaining design capacity of their landfill, land application, and injection well operations (Tennessee Rule 1200-1-11-.08).

Under the Hazardous Waste Management Act of 1983, fees for the State's remedial action fund are charged on the generation and transportation of hazardous waste. The "generation fee," based on a size classification of generators, has been structured by administrators to encourage recycling, and to discourage land disposal. No fees are imposed on generators who recycle their wastes (for the portion recycled) or have their wastes recycled. For generators in fiscal year 1983-1984, the maximum fee was $7,500 and the minimum fee $300. The "offsite shipment fee," an additional fee, is collected from generators who ship hazardous waste offsite for treatment or disposal. In fiscal year 1983-1984, this fee was $7.00 per ton. The Act allows annual adjustments to be made in both fee structures to reflect any changes in the revenue needs of the remedial action effort. State appropriations to the fund match revenue collections dollar-for-dollar (Tennessee Code Sec. 68-46-203, Rule 1200-1-13-.02).

Generators who recover hazardous waste for recycling may receive exemption from generator fees administered under the State's Superfund program. Exclusions are granted on approval of the generator's application to the Division of Solid Waste Management (Tennessee Code Sec. 68-46-203(b)(2)(C)).

IV. Loan and Bond Assistance

Tennessee has a program that provides loans, in the form of revenue bonds, to cities and counties for resource recovery facilities. The current capacity of the State to issue money as needed is $100 million. Cities or counties must have the capability to pay off the bonds, which are good for the life of the facility or up to 20 years (personal communication with Bobby Morrison, Tennessee DHE, January 30, 1986).

V. Grant Programs

Tennessee presently does not award grant monies to generators and other organizations as an incentive for waste minimization efforts.

VI. Information Programs

The State of Tennessee received an EPA add-on grant in Fall 1984 to aid in promoting waste reduction activity. The State, through its Department of Economic and Community Development, is currently using the grant to fund studies of applicable waste reduction techniques in small businesses. The aim of the program is to select representative facilities within specific industrial categories (e.g., furniture fabricators) and to conduct waste audits to identify cost-effective waste reduction measures. The results will appear in the form of feasibility studies for individual facilities, generalized studies for each industry category, and regional studies. A consulting firm has been hired to perform the work.

The consultant is also required to hold waste minimization technical workshops in the regions of the State where generators are selected. This is to broaden the dissemination of the information collected within the 15-month grant period.

The add-on grant was made in the amount of $90,000 and was matched with $10,000 from the State of Tennessee. Depending on the success of the effort and the prospects for future funding, the State may gradually phase in a waste reduction program by allocating permanent funding and staff, or by contracting with a consultant. To showcase the pilot program's successes, the Governor's Safe Growth Team is planning a waste minimization conference to be held March 4-6, 1986.

VII. Award Programs

Tennessee currently has no award program that provides recognition and honor to individuals or organizations that have demonstrated outstanding achievement in hazardous waste management.

VIII. Publications and References

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APPENDIX J.11

WASHINGTON

J.11 Washington

Washington State is active in promoting hazardous waste minimization through regulatory programs, annual fee assessments on generators and facilities, and its Priority Waste Management Study, which attempts to determine the best waste management practices for different waste categories and strategies to achieve such management.

I. Legislative Background

The State of Washington initiated a number of efforts to regulate hazardous waste prior to the enactment of RCRA by the Federal Government. In 1976, the State enacted the Hazardous Waste Disposal Act, which charged the Washington Department of Ecology (DOE) with the responsibility for regulating the production, transportation, and disposal of extremely hazardous waste. Federal and State regulations were incorporated into one set of "Dangerous Waste Regulations" in 1982. They were amended in 1984 to include the regulation of polychlorinated biphenyls under 50 ppm.

In 1983, legislation was passed specifying preferred hazardous waste management practices. Substitute Senate Bill 4245 established a set of priorities for managing hazardous waste. These priorities, in order of importance, were:

1. Waste reduction;
2. Waste recycling;
3. Physical, chemical, and biological treatment;
4. Incineration;
5. Solidification/stabilization; and
6. Landfilling.

The bill also directed DOE to complete a study of the best management practices for each category of waste by July 1, 1986, and to prepare new rules to promote priority waste management practices. DOE was also authorized to offer consulting and technical assistance services in this endeavor.

Substitute House Bill 1438 directed DOE to determine by July 1, 1986, the waste categories that are most suitable for landfilling. Until that time, all land disposal of hazardous waste at commercial offsite facilities is prohibited, as is the construction of new landfill facilities.

The Hazardous Waste Control and Elimination Account Act is the legislation that set aside funds for hazardous waste activities. The account is to be used (1) to implement the hazardous waste and substances regulation control program, (2) to encourage waste recycling and reduction, (3) to clean up sites, and (4) to provide CERCLA matching funds. The account is supported by fees charged to generators and facilities.

II. Regulatory Programs

Washington's land disposal bans on certain substances and legislative directives for facility siting both indirectly promote recycling and source reduction. The land disposal of all hazardous waste was banned under Substitute House Bill 1438 until July 1, 1986, or until a study of landfill suitability is completed for each waste or waste category. To implement this legislation, a two-phase study (Phase A and Phase B) was designed by DOE. Phase A studies those wastes most likely to require landfill disposal (inorganics). Phase B studies organic wastes. Phase A of the study has been completed and the landfill restrictions on inorganic wastes have been lifted.

To expedite the siting of hazardous waste facilities, both houses of the State legislature have passed bills that allow the State to preempt local government authority in determining feasible locations for incineration and disposal facilities. These bills also require county governments to develop waste management plans that include potential sites for treatment, storage, and recycling facilities. The State's responsibilities under the provisions of these bills are for incineration and disposal facilities, whereas responsibility for treatment, storage, and recycling facilities is left to the local government.

III. Fee and Tax Incentives

The Hazardous Waste Control and Elimination Account Act established a system of annual fee assessments on hazardous waste generators and facilities. The amount of the generator's fee depends on: (1) risk classification, which is assigned according to the type of waste produced and the amount produced per year, and (2) the gross income of the waste generator. As an example of the generator risk classification, a generator producing between 0.1 tons and 0.2 tons of extremely hazardous waste per year or between 2.0 and 3.5 tons of dangerous waste per year would be designated G3. The amount of the hazardous waste facility fee depends on the facility risk classification alone, which is determined according to the type of waste disposed, the amount disposed, and the method of disposal. A facility treating between 3 and 26 tons of extremely hazardous waste per year or between 30 and 260 tons of dangerous waste per year would fall under facility risk classification F5, for example.

The schedule of fees for generators and facilities is as follows (Washington Admin. Code 173-305-030,-060,-070):

Schedule of generator fees

	Generator gross income (M equals millions)		
Risk class	Less than $1 M	$1 M - $10 M	Greater than $10 M
G1	$ 15	$100	$1,000
G2	40	300	3,000
G3	65	500	5,000
G4	90	600	6,000
G5	115	675	6,750
G6	140	725	7,250
G7	150	750	7,500

Schedule of facility fees

Risk class	Amount per annum
F1	$ 750
F2	1,500
F3	4,000
F4	5,000
F5	6,500
F6	7,250
F7	7,500

IV. Loan and Bond Assistance

Washington currently offers no credit assistance in the form of loans or bonds for waste minimization efforts. The Priority Waste Management Study, however, is considering such a strategy (Moellendorf 1985).

V. Grant Programs

Washington presently does not award grant monies to generators and other organizations as an incentive for waste minimization efforts, although this approach may be considered for future programs, especially for research and development (Moellendorf 1985).

VI. Information Programs

A. Priority Waste Management Study

Under Senate Bill 4245, DOE is directed to conduct a study to determine the best management practices for each waste category and make recommendations on implementation of waste management priorities. These efforts are currently underway. DOE is working with a subcommittee composed of representatives from major industry, local government, and public interest groups to develop a list of recommendations. Tentative suggestions include technical and public information programs, a waste exchange, financial disincentives to landfilling, and additional restrictions on certain hazardous wastes going to landfill facilities (Moellendorf 1985).

VII. Award Programs

Washington State currently has the Environmental Excellence Award Program. Washington DOE proposes to expand the program and to liberally give awards as a positive way of recognizing achievements in managing hazardous waste by the higher priority methods (Moellendorf 1985).

VIII. Publications and References

Moellendorf, G.V. 1985. Progress report: priority waste management study for Washington state hazardous waste. Olympia: Washington Department of Ecology.

Washington DOE. 1983. 1982 Annual dangerous waste report. Office of Hazardous Substances and Air Quality Programs.

_____. 1984. Hazardous waste: 1983 annual report. Office of Hazardous Substances and Air Quality Programs.

APPENDIX K

TWO PROPOSED REGULATIONS ON HAZARDOUS WASTE MANAGEMENT BY TWO COUNTIES IN CALIFORNIA

K.1 Sacramento County

EXHIBIT II (continued)

a) Uses permitted outright
   - Assembly of small electronic equipment
   - Computer programming/software and system design
   - Data processing service
   - Laboratory, medical, dental, or optical
   - Office, administrative, of bank, savings and loan, finance, loan, credit
   - Office, business or professional

b) Uses permitted subject to issuance of a use permit by the Project Planning Commission:

   - Laboratory, materials testing
   - Laboratory, research and analysis, including but not limited to:
     - Biochemical
     - Chemical
     - Genetics
     - Environmental and natural resources
     - Film and photography
     - Electronics
     - Fiber optics
     - Instrumentation
     - Laser Optics
     - Medical, dental, surgical
     - Metallurgy
     - Pharmaceutical
     - Robotics
     - Solar
     - Sonics and Sound Imaging
     - X-Ray
   - Educational, training facilities related to other permitted uses.

19. Comply with all Federal, State, and County Hazardous Materials Regulations.

20. Handlers of hazardous materials shall prepare a hazardous materials management plan (HMMP), to be submitted to the Planning Director, including the following standards and elements:

    a) All storage tanks for hazardous materials shall be designed with leak detection systems and secondary containment.

    b) Underground storage of hazardous materials shall be limited to Class I flammable materials.

    c) All air emissions including, but not limited to, process emissions and tank venting, shall be treated to remove or reduce hazardous air contaminants. Systems to remove or reduce hazardous air emissions shall be reviewed and approved by the Sacramento County Air Pollution Control Officer prior to any handling of hazardous materials.

d) Prior to any handling of hazardous materials, handlers shall prepare a contingency plan for spills, fires, or other incidents involving hazardous materials accidents. Such contingency plans shall be prepared in cooperation with and reviewed by the Citrus Heights Fire Department, the Sacramento County Sheriff and the California Highway Patrol.

e) Wastewater shall be treated to minimize the content of volatile organic solvents, heavy or toxic metals, halides, and other hazardous materials, and to avoid extremes of pH in the waste stream. Treatment protocols shall be reviewed and approved by the Regional Sanitation District.

f) Prior to any handling of hazardous materials, users shall prepare a mass balance analysis program (MBAP), subject to review and approval of the Planning Director in consultation with the County Health Department. The MBAP shall provide a means of monitoring and accounting for all hazardous materials at all times from arrival on site through ultimate disposition, including material storage, movement, processing or fabrication, analysis, waste storage, treatment, discharge, product storage and shipment off-site. Adequate monitoring shall be provided to detect any losses, which shall be immediately reported to appropriate agencies.

g) Hazardous wastes stored on-site shall be inventoried and reported to the Citrus Heights Fire Department at intervals not to exceed fifteen days.

21. A Native American person as recommended by the Native American Heritage Commission should be consulted for the cultural resources survey.

22. Dedicate or grant to SMUD all necessary easements for needed electrical facilities to serve the development.

23. The applicant should coordinate with SMUD staff to assure implementation of the following Conservation and Load Management Measures:

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K.2 Santa Cruz County

ORDINANCE NO. ___________

ORDINANCE REPEALING CHAPTER 11.38, REPEALING CHAPTER 11.39, ADDING CHAPTER 11.37 AND AMENDING SUBSECTION (c) OF SECTION 18.10.111 OF THE SANTA CRUZ COUNTY CODE RELATING TO HAZARDOUS MATERIALS

The Board of Supervisors of the County of Santa Cruz do ordain as follows:

SECTION I

Chapter 11.38 of the Santa Cruz County Code is hereby repealed.

SECTION II

Chapter 11.39 of the Santa Cruz County Code is hereby repealed.

SECTION III

Chapter 11.37 is added to the Santa Cruz County Code to read as follows:

HAZARDOUS MATERIALS

Sections:

PART I
GENERAL PROVISIONS

11.37.010 Findings and Intent
11.37.020 Purpose
11.37.030 General Obligation - Safety and Care
11.37.040 Specific Obligation
11.37.050 Definitions
11.37.060 Designation of a Hazardous Materials User
11.37.070 Professional Assistance for County Determinations

PART II
MATERIALS REGULATED

11.37.100 Materials Regulated
11.37.110 Exclusions

PART III
STORAGE OF HAZARDOUS MATERIALS

11.37.200 Containment of Hazardous Materials
11.37.210 New Storage Facilities
11.37.220 Other Storage Facilities
11.37.230 Variance
11.37.240 Abandoned Storage Facilities

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PART IV
HAZARDOUS MATERIALS MANAGEMENT PLAN

11.37.300 The Hazardous Materials Management Plan
11.37.310 Standard Form Hazardous Materials Management Plan
11.37.320 Short Form Hazardous Materials Management Plan

PART V
HAZARDOUS MATERIALS DISCLOSURE FORM

11.37.400 Filing a Hazardous Materials Disclosure Form
11.37.410 Content of the Disclosure Form
11.37.420 Exemption to Disclosure
11.37.430 Trade Secrets and Exemptions from Public Disclosure

PART VI
RESPONSIBILITIES

11.37.500 The Hazardous Materials Permit
11.37.510 The Hazardous Materials Management Plan
11.37.520 Unauthorized Releases - Reporting
11.37.530 Unauthorized Releases - Repair
11.37.540 Unauthorized Releases - Cleanup Responsibility
11.37.550 Unauthorized Releases - Indemnification
11.37.560 Handling, Emergency Procedures and Access

PART VII
INSPECTIONS AND RECORDS

11.37.600 Inspections - Authority
11.37.610 Inspections
11.37.620 Maintenance of Records - County
11.37.630 Maintenance of Records - Applicants

PART VIII
PERMIT PROCESS

11.37.700 Requirement for Permit
11.37.710 Required Information for Permit Application
11.37.720 Permit Issuance, Amendment and Transfer
11.37.730 Fees for Permit
11.37.740 Appeal Procedure

PART IX
ENFORCEMENT

11.37.800 Revocation or Suspension
11.37.810 Criminal Penalties
11.37.820 Civil Penalties
11.37.830 Citizens Right to Act
11.37.840 Civil Action for Retaliation
11.37.850 Remedies Not Exclusive

PART X
MISCELLANEOUS

11.37.900 Duties are Discretionary
11.37.910 Disclaimer of Liability
11.37.920 Regulations
11.37.930 Conflict with Other Laws
11.37.940 Severability
11.37.950 Initial Compliance Schedule

11.37.010 FINDINGS AND INTENT. The County Board of Supervisors finds and declares:

(a) Hazardous materials present in the community may pose acute and chronic health hazards to individuals who live and work in this County, and who are exposed to such substances as a result of fires, spills, industrial accidents, or other types of releases or emission. Additionally, many hazardous materials present a serious health risk, even when emitted in low levels over long periods of time.

(b) Mishandling of small amounts of many of these substances has resulted in widespread and serious contamination of soil, air and groundwater.

(c) The cleanup of soil and groundwater contaminated with toxic chemicals can cost 100 times more than the original cost of properly containing and handling the hazardous materials responsible for the pollution.

(d) It is the responsibility of all businesses to protect their workers and the public from hazardous materials they use.

(e) It is technically and economically feasible to design manufacturing and commercial facilities that eliminate or minimize the release of hazardous contaminants.

(f) Aggressive efforts to control hazardous materials will enable companies to reduce technological obsolescense and eliminate the need to undertake expensive retrofit projects to comply with new regulations.

(g) Many state and federal programs have solved one type of toxic pollution problem by redirecting the contamination to another part of the environment, rather than eliminating the hazard. The County, however, has the responsibility and the authority pursuant to the County's Environmental Guidelines to plan to protect human health and the environment from all significant adverse effects resulting from the use and handling of hazardous materials.

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(h) It is the intent of the County Board of Supervisors that this Chapter shall recognize the County's responsibilities, its right to act to protect public health, life, and the environment from toxic contamination. It is the intent of the Board of Supervisors that the Chapter shall foster the best available industrial processes and best practical control technology to minimize potential contamination. This ordinance shall condition the use of hazardous materials by placing an obligation on the users to strictly control their emissions, discharges and releases.

(i) It is further the intent of the County Board of Supervisors to require that hazardous materials users monitor their emissions into the environment and keep records on the effectiveness of their hazardous materials management practices as a means of enforcing their obligation.

(j) The people who live and work in this County have a right and need to know of the use and potential hazards of hazardous materials in the community in order to plan for and respond to potential exposure to such materials.

(k) Basic information on the location, type and health risks of hazardous materials used or stored in the County should be available to firefighters, health officials, planners, elected officials or residents.

(l) It is the intent of the County Board of Supervisors that this Chapter shall recognize the community's right to know basic information on the use and storage of hazardous materials in the County and that it shall establish an orderly system for the provision of such information.

(m) It is further the intent of the County Board of Supervisors that the system of the disclosure set forth in this Chapter shall provide the information essential to firefighters, health officials, planners, elected officials, and residents in meeting their responsibilities for the health and welfare of the community in such a way that any statutory privilege of trade secrecy is not abridged.

(n) The Board of Supervisors hereby finds and determines, on the facts relevant to disclosure of the precise location within a facility where hazardous materials are stored or handled, that the public interest served by not disclosing such information to the public clearly outweighs the public interest served by disclosure of such information.

11.37.020 PURPOSE. The purpose of this Chapter is the protection of health and life, the environment, and property by placing on the users of hazardous materials the obligation to control releases, emissions or discharges of all hazardous materials, to properly handle all hazardous materials and to disclose their whereabouts.

PART IV

HAZARDOUS MATERIALS MANAGEMENT PLAN

11.37.300 THE HAZARDOUS MATERIALS MANAGEMENT PLAN. Each applicant for a Permit pursuant to this Chapter shall file a written plan, for the Health Officer's approval, to be known as a Hazardous Materials Management Plan (HMMP), which shall demonstrate the safe handling and control of hazardous materials. The HMMP may be amended at any time with the consent of the Health Officer. Those hazardous materials users that frequently initiate signficant changes, as defined in Section 11.37.050 and referred to in Section 11.37.400, in handling of a hazardous materials should indicate that information in the plan, or file an amended plan. The HMMP shall be a public record, except for items designated as trade secrets in accordance with the provisions of Section 11.37.430 and except for information contained in the General Facility Description and the Facility Storage map or line drawing of the facility, as herein provided.

11.37.310 STANDARD FORM HMMP. The Standard Form HMMP shall consist of the following:

(a) Facility Information:

1. General Information. The Standard Form HMMP shall contain the name and address of the facility and business phone number of applicant, the name and titles and emergency phone numbers of the primary response person and two alternates, the number of employees, number of shifts, hours of operation, and principal business activity.

2. General Facility Description.

(i) The Standard Form HMMP shall contain a map drawn at a legible scale and in a format and detail determined by the Health Officer. It shall show the location of all buildings and structures, chemical loading areas, parking lots, internal roads, storm and sewer drains, and shall specify the uses of adjacent properties.

(ii) The Health Officer may also require information as to the location of wells, flood plains, earthquake faults, surface water bodies, and/or general land uses (schools, hospitals, institutions, residential areas) within one mile of the facility boundaries.

3. Facility Storage Map.

(i) The Standard Form HMMP shall contain a Facility Storage Map at a legible scale for licensing and enforcement purposes. The information in this section is provided for purposes of ensuring the suitable and secure storage of hazardous materials and for the protection and safety of emergency response personnel.

(ii) The Facilities Storage Map shall indicate the location of each hazardous materials storage facility, including all interior, exterior, and underground storage facilities, and access to such storage facilities. In addition, the map shall indicate the location of emergency equipment related to each storage facility, and the general purpose of the other areas within each facility.

(iii) For each storage facility, the map shall contain information as prescribed below:

(1) A floor plan to scale and the permit quantity limit.

(2) For each hazardous material the general chemical name, common/trade name, major constituents for mixtures, United Nations (UN) or North American (NA) number, if available, and physical state.

(3) For all hazardous mateials, including wastes, stored in each storage facility, the hazard class or classes and the quantity for each such class.

(4) For tanks, the capacity limit of each tank, and the hazardous material contained in each tank by general chemical name, common/trade name, major constituents for mixtures, United Nations (UN) or North American (NA) number, if available, and physical state.

The Facility Storage Map shall be updated annually or whenever an additional approval is required for the facility.

(b) An Environmental Audit. Hazardous materials users shall provide the Health Officer, and themselves, with an environmental audit of each process using a hazardous material or materials. The environmental audit shall include:

1. A list of all hazardous materials that will be stored, produced or used in production, assembly and cleaning processes (a copy of the Hazardous Materials Disclosure Form as provided in Part IV herein may satisfy the requirements of this subparagraph);

2. Diagrams showing the flow of all hazardous materials through each step of these processes;

3. Diagrams and descriptions of all processes that produce wastewaters, air emissions, or hazardous wastes;

4. Diagrams and descriptions of all treatment processes for hazardous materials, including information on their efficiency in removing or destroying hazardous contaminants;

5. Estimates of the type and volume of hazardous materials that will be incorporated into final products, discharged into the sewer, released into the air, or transformed into hazardous wastes; and

6. A description of the methods to be utilized to ensure separation and protection of stored hazardous materials from factors which may cause a fire or explosion, or the production of a flammable, toxic, or poisonous gas, or the deterioration of the primary or secondary containment.

(c) Control of Emissions, Discharges and Releases. The Standard Form HMMP shall indicate the measures employed to control emissions, discharges and releases of each hazardous material, by:

1. Showing that the user has a permit or license from the appropriate regulatory agency.

2. Explaining how the user adheres to existing laws, statutes, standards or regulations that do not require a permit or license, but do specifically cover the handling of each hazardous material and specifically require its control.

3. Documenting measures that will be employed to control the hazardous material in such a manner as to present the least acute or chronic hazard or risk to public health, and/or least damage to the environment, including, but not limited to:

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(i) The best available control technologies, practicable, or

(ii) Changes in process and manufacturing strategies to reduce handling of the hazardous material.

4. Demonstrating the adequacy of:

(i) Contingency plans for spills and unauthorized emissions, discharges and releases of the hazardous material; and,

(ii) Employee training and equipment for proper handling of hazardous materials, and in response to all emergencies involving the hazardous material.

5. Upon a showing the environmental fate of the hazardous material handled is such that it presents no harm or potential of harm to human health or to the environment, the HMMP need not indicate the measures employed to control emissions, discharges, and releases of each hazardous material.

(d) Monitoring Plan. For each hazardous material used, the user shall document the efforts to verify that the hazardous materials are controlled in accordance with all other elements of the HMMP:

1. These efforts shall include, but are not limited to:

(i) Sampling of emissions discharges and releases;

(ii) Self-inspections of storage, manufacturing, and transportation operations; and

(iii) Testing of emergency procedures.

2. These efforts shall take place in such a manner as to:

(i) Include sampling, self-inspections and monitoring at those times during the production process when the highest volume discharges and the highest probable concentrations of hazardous materials are likely to occur;

(ii) Monitor, inspect or sample all hazardous materials used in the manufacturing process which have any potential for appearing in wastewater discharge; and,

(iii) Include periodic random sampling, monitoring or inspection.

(e) Recordkeeping Forms. The Standard Form HMMP shall contain an inspection check sheet or log designed to be used in conjunction with routine inspections. The check sheet or log

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shall provide for the recording of the date and time of inspection and, for monitoring activity, the date and time of any corrective action taken, the name of the inspector, and the countersignature of the designated safety manager for the facility or the responsible official as designated in the HMMP.

11.37.320 SHORT FORM HMMP.

(a) Any user handling an aggregate amount of less than 500 pounds of solids or 55 gallons of liquids or 200 cubic feet of a gaseous material at standard temperature and pressure, whichever is lesser, of a product or formulation containing a hazardous material may opt to file the Short Form HMMP unless the Health Officer has provided notice that he or she has lowered the weight or volume limits for a specific hazardous material to protect the public health.

(b) The Short Form HMMP shall consist of the following:

1. The Short Form HMMP shall contain the name and address of the facility and business phone number of applicant, the name and titles and emergency phone numbers of the primary response person and two alternates, the number of employees, number of shifts, hours of operation, and principal business activity.

2. The Short Form HMMP shall contain a simple line drawing of the facility showing the location of the use or storage facilities and indicating the hazard class or classes and physical state of the hazardous materials being used or stored and whether any of the material is a waste.

3. The Short Form HMMP shall also indicate the use and/or storage of any quantity of any carcinogen or reproduction toxin as defined in this Chapter.

4. Information indicating that the hazardous materials will be stored in a suitable manner and that they will be appropriately contained, separated and monitored.

5. Description of adequate contingency plans for spills and unauthorized emissions, discharges, and releases of the hazardous material and, employee training and equipment for proper handling of hazardous materials, and in response to all emergencies involving the hazardous material.

6. Assurance that the disposal of any hazardous materials will be in an appropriate manner.

PART V

HAZARDOUS MATERIALS DISCLOSURE FORM

11.37.400 FILING OF A HAZARDOUS MATERIALS DISCLOSURE FORM.

(a) Any user operating within the unincorporated areas of the County and handling hazardous materials shall submit a completed disclosure form to the Health Officer by January 1 of each year.

(b) In addition, any user shall file an amended disclosure form detailing the handling and other information requested on the form within 60 days of any:

1. Sigificant change in the handling of a hazardous material;
2. New handling of a previously undisclosed hazardous material;
3. Change of business address;
4. Change of business ownership; or
5. Change of business name.

11.37.410 CONTENT OF THE DISCLOSURE FORM.

(a) The disclosure form shall include the following:

1. Identification information, including but not limited to name, address and assessor's parcel number.
2. A copy of the MSDS for every hazardous material used by the person or business completing the disclosure; unless the MSDS has been previously filed pursuant to the requirements of this ordinance or does not exist.
3. A listing of the chemical name, any common names, hazard class and the CAS number and/or UN/NA number of every hazardous material handled by the person or business completing the disclosure form;
4. The EPA waste stream code, if available, of every hazardous waste handled by the person or business completing the disclosure form;
5. The estimated maximum amount of each hazardous material disclosed in either subsection 2 or 3 which is handled at any one time by the user over the course of the year;
6. Sufficient information on how and where the hazardous materials disclosed in subsections 2 and 3 are handled by the user to allow fire and safety personnel to prepare adequate emergency responses to potential releases of the hazardous materials;

7. The SIC code of the business, if applicable; and

8. The names and phone numbers of at least three persons representing the person or business and able to assist emergency personnel in the event of an emergency involving the person or business during nonbusiness hours.

(b) In an emergency, all users must immediately provide upon request information beyond that specifically required in the disclosure form to the agency of jurisdiction during the emergency if that agency has determined that such information is necessary to protect health and safety of the environment.

11.37.420 EXEMPTION TO DISCLOSURE.

(a) Fuel products that are regulated by the Uniform Fire Code shall be exempt from disclosure under Part V.

(b) A substance designated as a hazardous material by this Chapter solely by its presence on the Nuclear Regulatory Commission list of radioactive materials shall be exempt from the requirement that an MSDS be submitted with the disclosure form.

11.37.430 TRADE SECRETS AND EXEMPTIONS FROM PUBLIC DISCLOSURE.

(a) If a user believes that a request for information contained in the disclosure form or the HMMP involves the release of a trade secret, the user shall complete the documents nonetheless, but shall notify the Health Officer in writing of that information in the documents that the user believes involves the release of a trade secret. As used herein, trade secret shall have the meaning given to it by Section 6254.7 of the Government code and Section 1060 of the Evidence Code.

(b) Subject to the provisions of this Chapter, the Health Officer shall exempt from public disclosure any and all information coming into his or her possession which is claimed to involve the release of a trade secret, pursuant to subsection (a).

(c) Subject to the provisions of this Chapter, the Health Officer shall also exempt from public disclosure that portion of a Hazardous Materials Disclosure Form, the HMMP or other record on file which states the precise location where hazardous materials are stored or handled.

(d) Any information reported to or otherwise obtained by the Health Officer, or any of his or her representatives or employees, which is exempt from disclosure pursuant to subsections (b) or (c) shall not be disclosed to anyone except:

1. An officer or employee of the County, the State of California, or the United States of America, in connection with the official duties of such officer or employee under any law for the protection of health, or to contractors with the County and their employees if in the opinion of the Health Officer such disclosure is necessary and required for the satisfactory performance of a contract of work, or to protect the health and safety of the employees of the contractor; or

2. To a physician when the Health Officer determines that such information is necessary for the medical treatment of the physician's patient.

(e) For the purpose of this section, fire and emergency response personnel and County health personnel operating within the jurisdiction of the County shall be considered employees of the County.

(f) Information claimed as a trade secret must be disclosed to a physician by the Health Officer for the purpose of treating a patient. Any physician who, by virtue of his or her treating a patient has possession of or access to information the disclosure of which is prohibited on this section, and who, knowing that disclosure by this information is prohibited, knowingly and willfully discloses the information in any manner to any person not entitled to receive it, shall be guilty of a misdemeanor.

(g) Any officer or employee of the County or former officer or employee who, by virtue of such employment or official position has possession of or access to information the disclosure of which is prohibited by this section, and who, knowing that disclosure of the information is prohibited, knowingly and willfully discloses the information in any manner to any person not entitled to receive it, shall be guilty of a misdemeanor. Any contractor with the County and any employee of such contractor, who has been furnished information as authorized by this section, shall be considered to be an employee of the County for purposes of this Section.

(h) Information certified by appropriate officials of the United States, as necessarily kept secret for national defense purposes, shall be accorded the full protection against disclosure as specified by such official or in accordance with the laws of the United States.

(i) Upon receipt of a request for the release of information to the public which includes information which the user has notified the Health Officer is a trade secret pursuant to subsection (a) of this section, the Health Officer shall notify the user in writing of said request by certified mail. The Health Officer shall release the information, forty-five (45) days after the day of mailing said notice unless, prior to the

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expiration of said forty-five (45) days, the user institutes an action in an appropriate court for a declaratory judgment that such information is subject to protection under subsection (b) of this section and obtains a temporary restraining order or preliminary or permanent injunction prohibiting disclosure of said information to the general public.

Report to Congress

Minimization of Hazardous Waste

Executive Summary
and
Fact Sheet

October 1986

Printed on 75% Recycled Paper

L-i

Report to Congress

MINIMIZATION OF HAZARDOUS WASTE

Summary of Recommendations

The Environmental Protection Agency has concluded that mandatory standards of performance and required management practices are not feasible or desirable at this time. The Agency recommends that the effect on waste minimization of the land disposal restrictions and other HSWA mandates, as well as amendments to CERCLA, be quantified and analyzed. EPA will report back to Congress on this determination in December 1990, the earliest date at which it believes a recommendation on the need for a major waste minimization regulatory program could be made. Until that time, however, EPA recommends a three point waste minimization strategy:

Information Gathering

Continuing collection of information on waste stream volume and composition, generation rates by various types and sizes of generators, adequacy of capacity for TSD facilities, and the cumulative effect of HSWA requirements on voluntary waste minimization practices.

Core Waste Minimization Program

- Development and publication of informal guidance on waste minimization for the purpose of the reporting and certification requirements of HSWA Sections 3002 and 3005.
- Provision of a technical and information assistance program to generators and to States to aid in the development of waste minimization programs.
- Assistance to specific States to develop programs for providing direct technical assistance to generators (e.g., using waste audits, dissemination of technical information, applied research on new applications of existing technology).
- Highlight ongoing research and development and economic feasibility studies that might serve an entire region or have regional application.
- Development of an information system on waste minimization, accessible by the States.
- Implementation of mandatory controls, as needed, for controlling the generation of wastes for specific industries or processes using current authority under TSCA Section 6.
- Incorporation of waste minimization into the review of TSCA Premanufacture Notices.

Longer Term Options

After evaluation of information gathered in the short term, EPA may better assess in its 1990 report to Congress that additional authority to adopt mandatory standards of performance or management practices as a means of reducing wastes would be warranted.

In the interim, EPA will continue to examine the specific elements of the "core" waste minimization program and consider the need for longer term options, if needed. As part of the next RCRA reauthorization, EPA will provide Congress with its most current assessment of the need to modify the existing waste minimization requirements for generators and TSDFs. Among the possible options to consider would be:

- To prohibit, where appropriate, certification of certain types of waste management practices as waste minimization.
- To specify what may be certified as waste minimization.
- To define necessary documentation for certifications that state that waste minimization is not economically practicable.

Report to Congress on Minimization of Hazardous Waste

EXECUTIVE SUMMARY

This Report to Congress is submitted in response to the requirements of Section 8002(r) of the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act (RCRA) of 1976, and the Hazardous and Solid Waste Amendments (HSWA) of 1984.[1] Under this section, the Administrator of the Environmental Protection Agency (EPA) is required to submit a Report to Congress by October 1, 1986, recommending any legislative changes that are feasible and desirable to implement HSWA's policy with respect to the minimization of hazardous waste:

> The Congress hereby declares it to be the national policy of the United States that, wherever feasible, the generation of hazardous waste is to be reduced or eliminated as expeditiously as possible. Waste that is nevertheless generated should be treated, stored or disposed of so as to minimize the present and future threat to human health and the environment.

Section 8002(r) requires the Administrator to evaluate specifically the feasibility and desirability of:

1. Establishing standards of performance or of taking other additional actions under RCRA to require generators of hazardous waste to reduce the volume or quantity and toxicity of the hazardous waste they generate; and

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[1] Reflecting common usage, the amended Solid Waste Disposal Act will hereafter be generally referred to as RCRA. Additions to RCRA made by the 1984 amendments will be referred to in the text as HSWA.

2. Establishing, with respect to hazardous waste, required management practices or other requirements to ensure such wastes are managed in ways that minimize present and future risks to human health and the environment.

Definition of Terms

The following definitions, based in part on the interpretations presented below, are crucial to the recommendations made in this report (see also Figure 1):

> **Source reduction** refers to the reduction or elimination of waste generation at the source, usually within a process. Source reduction measures can include some types of treatment processes, but they also include process modifications, feedstock substitutions or improvements in feedstock purity, various housekeeping and management practices, increases in the efficiency of machinery, and even recycling within a process. Source reduction implies any action that reduces the amount of waste exiting from a process.
>
> **Recycling** refers to the use or reuse of a waste as an effective substitute for a commercial product, or as an ingredient or feedstock in an industrial process. It also refers to the reclamation of useful constituent fractions within a waste material or removal of contaminants from a waste to allow it to be reused. As used in this report, recycling implies use, reuse, or reclamation of a waste either onsite or offsite after it is generated by a particular process.
>
> **Waste minimization** means the reduction, to the extent feasible, of hazardous waste that is generated or subsequently treated, stored, or disposed of. It includes any source reduction or recycling activity undertaken by a generator that results in either (1) the reduction of total volume or quantity of hazardous waste, or (2) the reduction of toxicity of hazardous waste, or both, so long as the reduction is consistent with the goal of minimizing present and future threats to human health and the environment.

In the broadest sense, the HSWA defines waste minimization as any action taken to reduce the volume or toxicity of wastes. That definition includes the concept of waste treatment, which encompasses such technologies as incineration, chemical detoxification,

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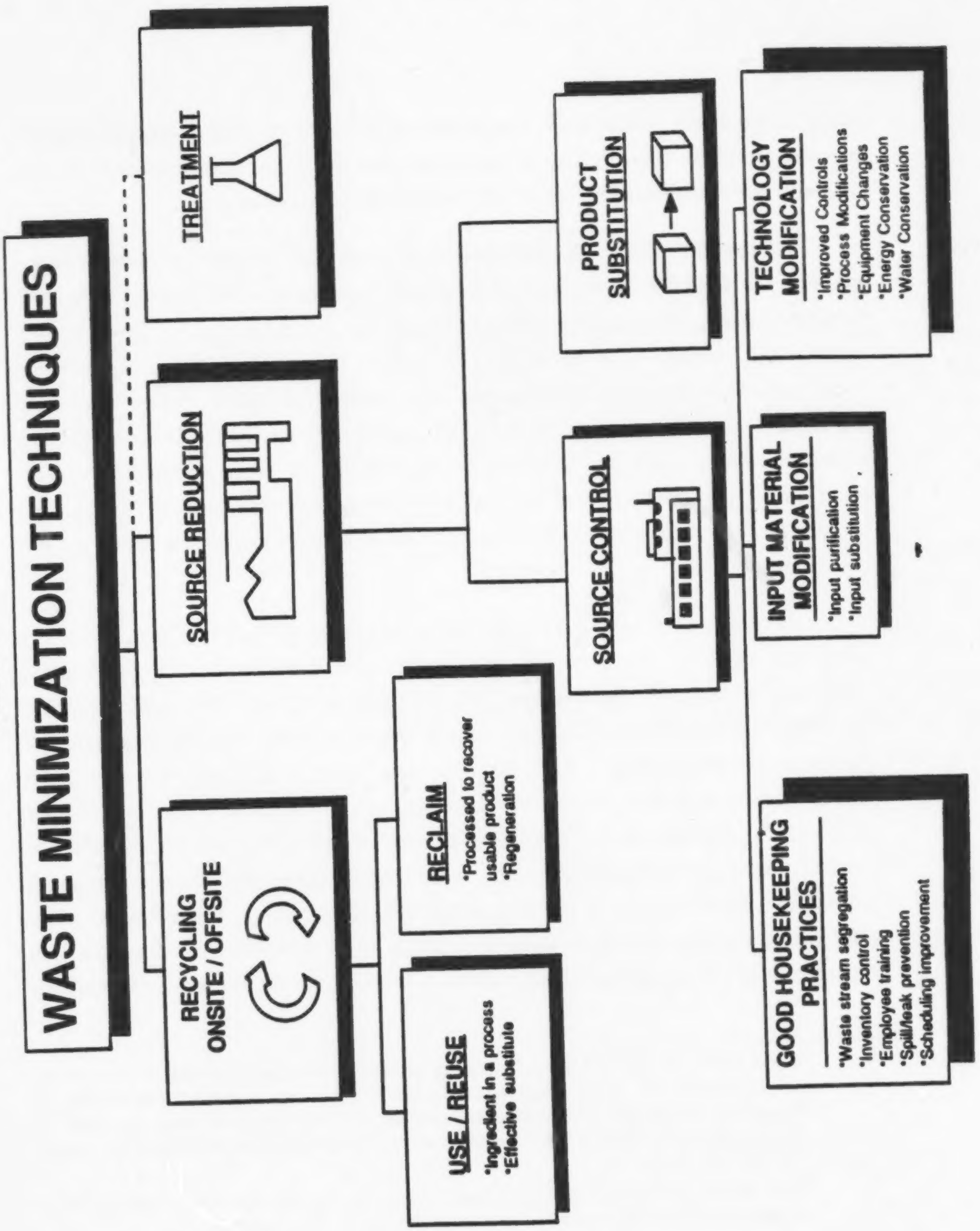
FIGURE 1


WASTE MINIMIZATION TECHNIQUES
RECYCLING ONSITE / OFFSITE
SOURCE REDUCTION
TREATMENT
USE / REUSE
*Ingredient in a process
*Effective substitute
RECLAIM
*Processed to recover usable product
*Regeneration
SOURCE CONTROL
PRODUCT SUBSTITUTION
GOOD HOUSEKEEPING PRACTICES
*Waste stream segregation
*Inventory control
*Employee training
*Spill/leak prevention
*Scheduling improvement
INPUT MATERIAL MODIFICATION
*Input purification
*Input substitution
TECHNOLOGY MODIFICATION
*Improved Controls
*Process Modifications
*Equipment Changes
*Energy Conservation
*Water Conservation

biological treatments, and others.[2] The Agency has already embarked on a broad program for waste treatment; thus, this report focuses on source reduction and recycling, the two aspects of waste minimization where basic options still remain open.

Section 1003 of HSWA establishes the general national policy in favor of waste minimization and refers to the need to reduce the "volume or quantity and toxicity" of hazardous wastes. EPA does not interpret this language to indicate that Congress rejected volume reduction alone (with no change in the toxicity of hazardous constituents) as being a legitimate form of waste minimization. A generator that reduces the volume of its hazardous waste, even if the composition of its waste does not change, is accomplishing beneficial waste minimization. EPA believes that waste concentration may occasionally be a useful waste minimization technique (e.g., in preparing materials for recycling). The key concept, however, is that waste minimization must be protective of human health and the environment.

Because both volume and toxicity of wastes present dangers to human health and the environment, measuring the effectiveness of waste minimization will be complex. First, waste minimization measures are likely to be process and industry specific, implying that different measurement techniques might be needed in different contexts; second, any mandatory requirements for reducing the volume or toxicity of generated waste should directly relate to expected reductions in risk to human health and the environment. EPA has already developed data and methodologies that can be used to evaluate the risks of many types of waste streams, as well as the risk reductions associated with waste management practices.[3] These evaluation techniques will continue to improve and become more effective as a tool in regulatory decision making. EPA therefore intends to use such assessments as a means of measuring progress in waste minimization and to help establish priorities among or within possible waste minimization regulatory schemes. This approach is consistent with the general principle that any waste minimization regulations should seek to reduce significant remaining risks.

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[2] Section 1003(a)(6) of HSWA states that the objectives of "promot[ing] the protection of health and the environment and conserv[ing] valuable material and energy resources" can be done by "minimizing the generation of hazardous waste and the land disposal of hazardous waste by encouraging process substitutions, materials recovery, properly conducted recycling and reuse, and *treatment*" [italics added].

[3] These include, for example, the Liner Location Model and the RCRA Risk/Cost Analysis Model (usually referred to as the Waste-Environment-Technology or W-E-T model).

Why Minimize Waste?

The RCRA program over the past ten years has focused primarily on correcting the effects of years of poor management of hazardous wastes by bringing treatment, storage, and disposal facilities into compliance with national standards that are protective of human health and the environment. HSWA has continued this policy, but has also shifted the emphasis of the program away from reforming land disposal practices to a reliance on waste treatment. Because of its potential for contamination of other environmental media (e.g., ground water), land disposal—even under strict control—is recognized as the least desirable method of managing hazardous wastes.

The move toward treatment is a major step forward, but is not a complete answer. Reforms in land disposal practices and installation of new hazardous waste treatment capacity are effective responses to managing this country's hazardous waste, but they do not address the generation of these wastes. Both Congress and EPA believe that preventing the generation of a waste, when feasible, is inherently preferable to controlling it after it is generated. Waste minimization can be viewed as a means of reducing the introduction of hazardous constituents into all environmental media.

Current environmental control programs are designed to protect human health and the environment. However, control technologies are never 100 percent efficient, and compliance with regulations under any environmental program can never be perfect, even with the most stringent enforcement program. Waste minimization can also address the risks of breakdowns in waste management systems.

In addition to achieving human health and environmental benefits by reducing the volume and/or toxicity of hazardous wastes, waste minimization can also relieve shortages of treatment, storage, and disposal capacity. The capacity to accept wastes diverted from land disposal will be especially limited over the next few years while new facilities are under construction and treatment alternatives are being developed. This process may be slow, since public opposition makes new hazardous waste facilities extremely difficult to site. Furthermore, land disposal will continue to be required into the foreseeable future, even if wastes disposed of in or on the land are detoxified first; hence, capacity needs will always be a concern. Finally, all forms of waste management—treatment or land disposal—must allow for industrial growth and thus the need for additional capacity. By reducing per unit product generation rates, waste minimization can provide at least a partial answer to these problems.

Incentives and Disincentives for Waste Minimization

Strong incentives already exist to promote waste minimization in the private sector, including (1) dramatic increases in the price of all forms of hazardous waste management, partially caused by Federal and State standards, (2) difficulties in siting hazardous waste management capacity, (3) permitting burdens and corrective action requirements, (4) financial liability of hazardous waste generators, (5) sharp increases in the cost of commercial liability insurance, coupled with a steep dropoff in its availability, and (6) public pressure on industry to reduce the production of waste. There are also countervailing disincentives. Figure 2 covers the incentives and disincentives that surround the various waste minimization techniques.

Incentives for Waste Minimization

Increases in the costs of hazardous waste management: EPA and State regulations have been the primary cause of increased costs in treatment, storage, and disposal of hazardous wastes, especially in relation to landfills, surface impoundments, and storage and accumulation tanks. The current series of land disposal restrictions under HSWA will limit the number of untreated wastes that can be disposed of on land and thus are likely to increase the cost of disposal. HSWA also imposes more stringent standards on surface impoundments, which will mean that about half of those now in operation will close. In addition, the recently promulgated hazardous waste tank rules[4] will

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[4] 51 FR 25421, July 14, 1986

	Source Reduction	Offsite Recycling	Onsite Recycling
INCENTIVES			
Increased Cost of Waste Management	●	●	●
Difficulties in siting new HW management facilities	●		●
Permitting Burdens and Corrective Action Requirements	●	●	●
Financial Liability of HW Generators	●		●
Shortages of Liability Insurance	●		●
Public Perception	●	●	●
DISINCENTIVES			
Economic Barriers –Lack of Capital	●		●
–Financial Liability		●	
Technical Barriers –Attitudes toward unfamilar methods	●	●	●
–Batch Processes			●
–Lack of information	●	●	●
–Technical Limits of Process	●		
–Technical Quality Concerns	●		
Regulatory Barriers –Need to Obtain TSD Permit	●	●	●
–Perceived Stigma of Man'g Haz. Waste		●	●
–Revisions to Other Env. Permits	●	●	●

FIGURE 2 INCENTIVES AND DISINCENTIVES FOR VARIOUS WASTE MINIMIZATION TECHNIQUES

also increase waste management costs. Because of these three factors, generators must find alternative means for treating, storing, or disposing of their wastes.

Prices for such alternative waste treatment are expected to rise as generators compete for scarce treatment capacity (such as incineration or chemical detoxification). EPA has, in fact, already identified shortages of treatment and disposal capacity for solvent and dioxin wastes in its proposed regulations.[5]

Overall, the increased costs of waste management provide a strong incentive for owners and operators to reduce the quantity of waste generated or disposed of through the use of source reduction and offsite and onsite recycling techniques.

Difficulties in siting hazardous waste treatment, storage, and disposal capacity: The land disposal restrictions program, as mandated by HSWA, is creating a strong demand for substantial new waste treatment, storage, and disposal capacity. Hazardous waste managers are therefore seeking new sites and planning to expand existing ones, but in the process they are encountering the familiar problem of "not in my community." While there are some instances where States have been successful in helping to site new hazardous waste management facilities, local resistance tends to be extremely hard to overcome. This intense public opposition to the siting of many types of hazardous waste facilities may cause shortages to persist even when market demand is strong. Generators' only alternative in many cases may therefore be a reliance on source reduction and onsite recycling to reduce the amount of waste they would otherwise send to offsite management facilities.

Permitting burdens and corrective action requirements: Even though the demand for new treatment and disposal capacity will be high, permitting procedures will tend to delay the availability of that new capacity, temporarily driving up the costs of all forms of treatment and disposal. No new hazardous waste management facility may be constructed until it has acquired a RCRA permit—a costly process that usually takes several years to complete. In addition, all permits issued after November 8, 1984, include provisions requiring owners and operators to take corrective action for releases of hazardous waste, regardless of when it was placed in the unit, both within *and beyond* property boundaries as necessary to protect human health and the environment. This potentially very expensive requirement applies to all facilities seeking a new RCRA permit, including both existing and new facilities. Additionally, even though the demand for new treatment and disposal capacity will be high, permitting procedures will tend to delay the availability of that new capacity, temporarily driving up the costs of all forms of treatment and disposal.

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[5] 51 FR 1729, January 14, 1986

Thus, the increased costs of permitting burdens and corrective action provide still another strong incentive for owners and operators to reduce the quantity of waste generated or disposed of through the use of source reduction and offsite and onsite recycling techniques.

Financial liability of hazardous waste generators: Generators using offsite treatment, storage, or disposal face financial liability for two reasons: (1) there is a potential for mismanagement of wastes by facility operators, and (2) there is the possibility of improper design of the disposal facility itself. Even careful evaluation of facility management cannot reduce these risks to zero. A generator risks incurring liability when the treatment, storage, or disposal facility (TSDF) owner or operator cannot or will not pay for remedial or corrective actions made necessary by migration of wastes. In these situations, generators can be held liable under common law for absolute, strict, joint and several liability. In addition, the imminent and substantial endangerment provisions in Sections 106 and 107 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), state a generator or generators can be held financially responsible for the entire cleanup or restoration of a facility. When less waste is generated, it reduces potential liability for future disposal and thus is an incentive for both source reduction and onsite recycling.

Shortages of liability insurance: The traditional means for obtaining coverage for potential hazardous waste management liabilities is through insurance, but, for many generators and owners or operators of TSDFs, liability insurance is no longer available, or is available only at extremely high cost. This is particularly true of Environmental Impairment Liability (EIL) insurance, which until 1985 was an often-used financial instrument for generators and owners and operators of TSDFs to protect themselves from third-party and government claims for damages resulting from environmental releases of hazardous substances. In recent years, premiums have increased 50 to 300 percent, policies have been cancelled even where loss ratios have been excellent, and many companies have difficulty obtaining coverage at any price. In order to insure themselves against liability, TSDFs who must comply with Sections 3004 and 3005 (e) of RCRA[6] have resorted to creative methods to obtain coverage.[7] Until fundamental changes occur in the insurance marketplace, many generators and TSDFs will continue to have difficulty meeting liability requirements.

Increases in insurance costs or an inability to obtain insurance will result in higher treatment and disposal costs or the loss of available treatment or disposal capacity. This will provide a strong incentive to reduce the quantity of waste to be disposed of through the application of source reduction and onsite recycling techniques.

Public perception of company responsibilities: While the strongest incentives for implementing waste minimization techniques are probably economic, many companies are establishing waste minimization programs out of sensitivity to public concern over toxic chemicals. This type of corporate good citizenship is felt to produce good relations between industry and the public. Available information indicates that the larger companies are most likely to perceive public relations benefits in waste minimization; however, some medium and small size companies are acting under the same motives.

Disincentives for Waste Minimization

Economic barriers: Even though waste minimization practices often lead to cost savings, availability of capital for plant modernization is often a significant obstacle to their implementation. Although major companies may have sufficient access to upgrade inefficient processes, small and medium sized companies often do not. Firms that have recently modernized their facilities have reduced incentive to reinvest in alternative processes. Obstacles to plant modernization adversely affect the implementation of source reduction and onsite recycling when these involve process modifications.

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[6] Generators do not have to obtain liability insurance under RCRA.

[7] New instruments they have developed include: (1) formation of associations—captive stock or mutual insurance companies, (2) licensed carrier fronting programs for trust funds in which banks hold funds to cover liability, (3) letters of credit, (4) self insurance, and (5) corporate guarantees.

Financial liability can, in at least one circumstance, also be a significant disincentive for waste minimization because generators who send waste offsite may be liable under CERCLA and common law for damages caused by their wastes, even if the wastes have left the plant and are no longer under the firm's control. They may therefore not use available offsite recycling.

Technical barriers: Some firms may be reluctant to make any modifications to their production processes for fear of risking the technical quality of their final product. While these fears may not be well-founded, they can be a significant impediment to innovation.

There may also be, however, significant practical limits to waste minimization, especially with respect to source reduction, even where firms are actively seeking to minimize waste. Certain products simply cannot be manufactured without producing hazardous wastes; excessive waste minimization requirements would, in such cases, remove products from the market or put companies out of business entirely. A hazardous waste analog to the zero discharge policy, calling for across-the-board cuts of fixed percentages of waste generated, is therefore not realistic because, in some situations, possible source reductions may turn out to be minor and achievable only at great expense.

Another technical consideration affecting waste minimization is that industries producing high volume or high toxicity wastes often operate largely through batch processes. This can present problems for certain onsite recycling techniques (e.g., while light colored off-specification batches of paint can be blended into subsequent darker colored batches, the opposite is not always true).

Similarly, offsite recycling is often technically limited by process realities and administrative logistics. Off-specification chemicals (such as pesticides or pharmaceuticals) are examples of products with little onsite or offsite recycling potential. Even where wastes are technically recyclable, it may be difficult to accumulate enough waste to make the activity economically attractive. With respect to offsite recycling, it may be hard to establish permanent and stable relationships, either onsite among various production lines or offsite among firms; generator and user processes have to be synchronized, purity may vary over time, volumes of wastes available may not meet minimum reuse needs, transportation costs have to be acceptable, and price variations in feedstocks and in product prices inevitably play a crucial role.

Finally, the most significant technical barrier to waste minimization may often be a lack of suitable engineering information on source reduction and recycling techniques. Available information suggests that this is most often the case with small and medium sized companies.

Regulatory barriers: Some of the provisions of current environmental statutes, including RCRA, tend to discourage waste minimization. Some examples include the following:

- Source reduction sometimes requires the installation of new machinery that can, under RCRA, be considered "treatment." This in turn may require a plant to obtain a permit as a treatment, storage, and disposal facility (TSDF).
- Commercial recycling facilities that wish to increase their operations might be reluctant to do so if the expansion were to require a revision of their NPDES water pollution permit to authorize a change in the composition of their discharges or allow for larger flows.
- The new definition of solid waste, promulgated by EPA to eliminate loopholes in RCRA controls and inhibit unsafe (or "sham") recycling, brings some additional wastes into the hazardous waste system. This seems to be inhibiting some plants from sending these wastes offsite for recycling, since many companies perceive that manifested wastes present greater financial liability for offsite activities out of their immediate control. In addition, out of anxiety over potential financial liabilities, some companies not currently in the hazardous waste system may be reluctant to undertake any waste minimization program that would require them to accept manifested hazardous waste (e.g., certain offsite recycling practices) or take other measures that would bring them officially into the hazardous waste management system.

Current Waste Minimization Requirements

At present, there are three formal statutory requirements relating to waste minimization, all of them enacted as part of the 1984 amendments.

1. Section 3002(b) of HSWA requires generators to certify on their waste manifests (mandated under Section 3002(a)) that they have in place a program "to reduce the volume or quantity and toxicity of such waste to the degree determined by the generator to be economically practicable."
2. Section 3005(h) of HSWA requires the same certification in relation to any new permit issued for treatment, storage, or disposal of hazardous waste.
3. Section 3002(a)(6) of HSWA requires, as part of any generator's biennial report to EPA, that the generator describe "the efforts undertaken during the year to reduce the volume and toxicity of waste generated" as well as "changes in volume and toxicity of waste actually achieved during the year in question in comparison with previous years, to the extent such information is available for years prior to enactment of [HSWA]."

These requirements should increase the awareness of generators and facility owners and operators of the importance of minimizing hazardous wastes, and might serve as the basis for more specific and farther reaching requirements. However, the present requirements are not restrictive; the generator determines whether any particular waste minimization approach that might apply to his or her process is economically practicable.

Although the biennial reports should provide useful insight into what generators are actually doing to reduce wastes, they are not likely to provide definitive information. The reports due this year (1986) will be the first to include waste minimization requirements, and the quality of information they contain is expected to vary widely. As yet, for example, there is no formal definition of the meaning of the term "toxicity," or any guidance on the way to measure waste volume. In addition, generators are not likely to provide information that they consider confidential.

EPA is therefore conducting a study to determine how the waste minimization statement on the biennial report can be modified to improve the quality of information being reported. The Agency plans to provide uniform guidance directly to the States and to generators on the content of these reports in time for their 1988 submission. Future information provided in the report will then allow EPA to better identify trends in waste minimization technologies applied by generating facilities.

Evaluation of Available Options for Waste Minimization

Congress specifically required the Agency to report on the desirability and feasibility of establishing mandatory standards of performance for waste minimization or of taking additional actions under RCRA to reduce the volume or quantity and toxicity of hazardous waste and of establishing required management practices to achieve minimization. It also requested any recommendations for legislative changes to implement the national policy of waste minimization. This report details EPA's evaluation of the following options to minimize hazardous wastes.

Standards of Performance

Mandatory standards of performance for minimizing wastes could take various forms, but in all their variations they are markedly different in concept from the type of performance standards typical of the air and water pollution control programs. In these other programs, performance standards are end-of-pipe standards that allow flexibility to modify processes or add control technologies. Performance standards for waste minimization would depend substantially on internal modifications of industrial processes. Such standards would mark a major departure from past practice and would require statutory amendments. At present, mandatory performance standards are not authorized under RCRA.

EPA has evaluated three variations of performance standards in this report:

1. Specific standards limiting the volume or toxicity of wastes,
2. Prohibition or restriction of specific waste streams, and
3. A phasedown permit system, wherein total waste generation levels for one or more industries or waste streams are specified and then

reduced ("phased down") over time. Under this option, trades among firms for generation rights would be encouraged.

EPA believes that all these options raise significant implementation concerns and should be adopted only after careful evaluation of emerging trends and patterns of waste generation. It is important that the option selected be the most effective method to minimize hazardous waste for a particular industry. All performance standard options would be costly and time consuming to design and would, therefore, be infeasible to implement in the next four to six years. If it becomes clear after implementation of the land disposal restrictions program that there are specific residual hazardous waste problems that are not being resolved through response to these requirements, then additional prescriptive action may be appropriate. EPA might find that the Toxic Substances Control Act (TSCA), especially Section (6)(a)(A), is a more appropriate method than RCRA regulations to resolve residual hazardous waste problems.

A comprehensive command-and-control performance standard program of the traditional type would cost on the order to $5 to $7 million per standard to design and implement, and would require staff commitments at least as high as the effluent guidelines program for water or the new source performance standards program for air. At the present time, however, there are hundreds of discrete industrial processes to examine, and it is difficult to project without further information how many may require standards. Under the most realistic circumstances, it would take at least ten years after Congressional authorization to design and fully implement such a program.

Prohibition or restriction of specific wastes would presumably be simpler in regulatory structure and more selectively applied than performance standards, but would still require extensive research into processes and waste management techniques. Furthermore, responsible use of prohibition authority often requires substantial analysis of the feasibility of less severe measures and, therefore, can also be costly to evaluate.

A phasedown permit system would be somewhat different in concept and operation from a command-and-control performance standard approach. Because it would not set specific engineering standards for each industry, the burden on EPA for developing the program would be considerably less than for a conventional standard-setting process.

Incentives for trading among firms would be inherent in the system, since the number of permits would be limited to less than the current level of waste generated. The eventual value and distribution of permits would be set by the marketplace, with waste reductions coming from those firms that could reduce most cost-effectively. These firms would be able to sell any unused permits on the open market as "waste reduction credits." Moreover, since EPA would phase down the amount of waste generation allowed, the permits would increase in value over time, creating a continuous incentive to reduce waste further.

Phasedown permits would cost society far less than other performance standard options for achieving a given level of waste reduction if there are sufficiently wide variations in unit control costs among generators and if trades are actually made among firms. They do, however, raise novel implementation problems. Two concerns are the initial distribution of permits and the degree of trading to be allowed. However, these issues may be resolvable, as demonstrated by EPA's recent program to phase down the lead content of gasoline. A third concern is how to determine the rate of the phasedown and the amount of hazardous waste allowed at the end of the phasedown period.

Under any of these options, EPA would consider exempting small quantity generators from the requirements or would consider subjecting them to simplified and less burdensome requirements. Because small quantity generators collectively account for only a small fraction of the wastes generated annually,[8] subjecting them to stringent and expensive regulations may not be cost-effective or provide additional protection of human health and the environment.

Management Practices

Management practices, as defined in this report, are procedures or institutional policies within a service or manufacturing operation that result in a reduction in hazardous waste generation. They are a step beyond the directives established by performance standards and include requirements restricting particular disposal practices, requirements for the handling of wastes as they are generated, and requirements for controlling the waste generation system.

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[8] Small quantity generators regulated under RCRA are those who generate between 100 and 1,000 kilograms of hazardous waste per month. According to the *National Small Quantity Hazardous Generator Survey*, conducted for the Office of Solid Waste in 1985, small quantity generators, including those who generate less than 100 kilograms per month, collectively account for less than one half of one percent of the total quantity of waste generated annually.

Three management practices are discussed below. The first would ban the landfilling, treatment, or incineration of potentially recyclable wastes. The second would require the segregation of wastes to enhance recycling potential. The third would require mandatory waste audits.

Banning the landfilling, treatment, or incineration of potentially recyclable wastes would likely be controversial and possibly inefficient. In addition, while it would be possible to make sure that no proscribed waste is landfilled, treated, or incinerated, it would be exceedingly difficult to ensure that all such waste is properly recycled instead, thus making it difficult to enforce. Noncompliance (e.g., illegal dumping) would potentially be substantial.

A second possibility would be a requirement for segregation of waste streams and banning the mixing of waste streams that are potentially recyclable. This includes the isolation of hazardous materials from nonhazardous materials or the isolation of liquid from solid waste. The segregation of wastes does have the potential in selected instances to be economically attractive, and could, in fact, save some firms significant sums of money by reducing treatment and disposal costs, lowering expenses for the purchase of raw materials, and/or generating a reclaimed product that can be marketed or sent to a waste exchange. Waste stream segregation might, therefore, become economically attractive without additional regulation. It is conceivable that new prohibitions on land disposal and dramatically increased costs for all forms of disposal, coupled with substantial efforts to increase industry awareness of recycling possibilities, could provide adequate information and incentive for segregation without making such action a regulatory requirement.

Waste audits can be an effective means to identify opportunities for waste minimization, making audits mandatory, however, could undermine their effectiveness. While the direct costs of waste audits for industry are not extremely high (on average

$10,000 to $20,000 per audit for an uncomplicated facility)[9], requiring every waste generator to conduct an audit could have some detrimental effects. If they were seen as a Federal requirement rather than as a corporate initiative, plant personnel might tend to be less than forthcoming and the results of such audits often might be discounted and disregarded. A mandatory program might also require EPA to develop implementing regulations to address who is qualified to conduct waste audits and how audits should be conducted, and to monitor possible reporting requirements. Since it would be difficult to require compliance with the recommendations of a waste audit, such efforts do not seem justified.

It appears more desirable for EPA to promote voluntary waste audits on their own merits as a useful waste management tool, such as through a technical assistance program implemented through the States (see below). EPA and the States could develop programs that would include State certification and listing of qualified waste minimization auditors, targeted assistance programs for onsite audits, and development of model checklists and protocols for conducting audits. In the context of a voluntary audit approach, such programs should be less burdensome to develop and more flexible to implement than under a mandatory regime; thus, it is suggested as an EPA initiative.

Legislative Amendments to HSWA

EPA currently interprets the certification requirement under HSWA Section 3002 (generator standards) and Section 3005 (permit standards) as prohibiting the development of substantive requirements to generators on what constitutes appropriate waste minimization. As the Senate Report on the certification process emphasizes, the intent of the current requirement is merely to encourage generators to consider specifically the desirability and feasibility of waste minimization; it does not require specific waste minimization action.

The Agency believes that generators should continue to determine what their waste minimization options are and, at this time, that EPA should not make process related decisions to force waste minimization. However, EPA is further considering an option to amend the current legislation to allow EPA to define acceptable waste minimization practices. This authority could allow EPA to specify general practices that could or could not be certified as waste minimization (e.g., those practices that result in adverse cross-media pollution transfers). EPA is continuing to evaluate this change to the waste minimization certification statement, and will provide Congress a further assessment of the need to modify these requirements. Among possible options to consider include:

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[9] For smaller facilities, the costs could be substantially lower, perhaps under $5,000; however, for large, complex facilities, the costs could be substantially higher.

- Prohibit, where appropriate, certification of certain types of waste management practices as waste minimization.
- Specify what may be certified as waste minimization.
- Define necessary documentation for certifications that state that waste minimization is not economically practicable.

As additional information becomes available, the Agency could use this discretionary authority to focus on specific industries that continue to create potential risks to human health and the environment.

While small quantity generators might be subject to such additional reporting responsibilities under this option, EPA could consider subjecting them to less rigorous and burdensome requirements than those affecting large quantity generators.

Other Options

A number of other waste minimization options have been identified in the course of preparing this report. A full list of available options is found in the technical support document for this report, *Waste Minimization Issues and Options*. Several of the options listed there are not discussed here for various reasons: either they have been considered already under other authority (such as the provisions for a waste-end tax now under consideration as part of the CERCLA reauthorization), or they have been found, on further review, to be unworkable as part of RCRA (e.g., enforcement bounties). Appendix B to this report lists options that have *not* been evaluated or presented here and explains the reasons for their exclusion.

Two basic options for waste minimization that the Agency believes should definitely be considered as part of a short- or long-term waste minimization strategy are (1) technical assistance for waste minimization, implemented in cooperation with the States, and (2) modifications to Federal procurement practices to avoid discriminating against recycled commodities and, where appropriate, to support development of markets in recycled commodities.

An active, aggressive, and sustained program for technical assistance appears to be the strongest option available to promote waste minimization, especially in the near term. Carried out in cooperation with the States, such a program could be aimed primarily at small[10] and medium sized companies, which currently have the least access to information on how to minimize their wastes. The program's purpose would be to encourage firms to include waste minimization efforts in their hazardous waste management planning, to provide access to technical information, and to encourage the development of markets for recyclers and recycled materials. No new legislative authority would be required to launch such a technical assistance effort, but adequate and sustained support by Congress would be necessary over the next ten years if it were to achieve its potential.

RCRA already provides authorization for EPA to encourage revision of Federal procurement practices to promote the use of recycled products. Section 6002 of RCRA requires procuring agencies to amend Federal procurement practices to avoid unnecessary discrimination *against* recycled products, and requires EPA to promulgate procurement guidelines that actively promote the procurement of recycled products. This strategy may help achieve substantial increases in the market share of recycled products, particularly where the Federal government is a major consumer of a product. In such instances, a Federal preference for a recycled product may make the product economically viable. EPA should work with agencies that are in the best position to create such markets, including the Department of Defense and the Department of Energy.

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[10] "Small" companies are not intended to include only Small Quantity Generators as defined under RCRA. A technical assistance program would also be useful for small quantity generators, but the degree of emphasis on this group would have to be carefully reviewed. While small quantity generators do need (and often request) technical assistance, the available data suggest, as noted earlier, that they contribute only a very minor fraction (about one-half of one percent) of hazardous waste volume nationally.

Recommendations

At this time, the Agency believes that generators should continue to determine which waste minimization techniques are economically practicable and that EPA should not specify requirements for waste minimization.

If, after implementation of the other pertinent provisions of the HSWA, the Agency decides that standards of performance or required management practices are needed to protect human health and the environment, it will then request the necessary additional authority from Congress. EPA proposes to report to Congress on this issue in December 1990, the earliest date at which it believes a recommendation on the need for a mandatory waste minimization program could be made.

EPA does plan to expand its waste minimization efforts as discussed below in the context of EPA's proposed three-point waste minimization strategy.

The elements of this strategy are:

1. **Information Gathering:** Detailed data on industry's response to the land disposal restrictions program and other existing waste minimization incentives must be gathered in order to make a final determination on the desirability and feasibility of performance standards and required management practices.

2. **A Core Waste Minimization Program:** During the interval when the new provisions of HSWA are taking effect, EPA will launch a strong technical assistance and information transfer program through the States to promote voluntary waste minimization in industry, government, and the non-profit sectors of the economy. It will also work with Federal agencies to encourage procurement practices that promote the use of recycled and reclaimed materials.

3. **Longer Term Options:** Based on an analysis of the new data gathered under (1) above, performance standards and other mandatory requirements can be imposed, if necessary, once the

HSWA amendments have taken full effect and their impacts on waste generation have been assessed.

Information Gathering

Agency actions to encourage waste minimization, whether through voluntary means or through future regulatory action, must be based on a full understanding of the present state of hazardous waste generation and management and of how that system is evolving under the many pressures to which it is now being subjected. The general patterns and trends of hazardous waste management systems are becoming clearer, but past trends may not persist through the next four to six years as HSWA's new provisions take effect, and as industry seeks to control the potential financial liabilities associated with hazardous waste management.

Baseline and trends data: The best data available to the Agency on the amount and content of hazardous wastes were developed by surveys conducted in 1981 and 1983. These data are rapidly becoming out of date and are known to be of uneven quality because of reporting errors and the small and variable sample sizes from which information was extrapolated. They must be supplemented with new data documenting the changes that have already begun and will continue to progress over the next few years.

In order to make a final determination on the desirability and feasibility of mandatory waste minimization actions, the Agency must be able to document unresolved environmental problems for which such a new regulatory program would be the appropriate response. Examples might be waste streams for which treatment and disposal capacity remains inadequate even after the land disposal restrictions have been in place for a year or more, or a future EPA determination that a particular type of hazardous waste treatment method does not, in practice, adequately protect human health and the environment.

The types of data needed include detailed baseline information on the volumes and toxicity of wastes generated, trends data on source reduction and recycling, trends data on treatment and disposal capacity, and analyses of the human health and environmental impacts of treatment and disposal practices. EPA expects that existing statutory authority is sufficient to gather this additional data. One potential source will the biennial reports, which will be upgraded to improve the consistency and coverage of the information submitted. Other sources may include a new generator survey or the 1986 TSD survey currently being undertaken, information developed by EPA programs outside of the Office of Solid Waste (such as under TSCA), and the reporting requirements that may be enacted under amendments to CERCLA.

Data to support technical assistance and information transfer: Much of the same data can be used to set priorities for technical assistance programs to promote source reduction and recycling programs, targeting them where they will be most successful in reducing threats to human health and the environment. However, in-house research and cooperation with States and industry trade associations will provide more detailed information on the cost and effectiveness of specific waste minimization techniques for the targeted industries. This information gathering program will enable EPA to develop an accurate profile of waste management trends and practices and selectively develop performance standards or other requirements as needed.

A Core Waste Minimization Program

As this report has already emphasized, it is neither desirable nor practical to research, promulgate, and enforce a major regulatory program mandating specific waste minimization standards over the next four to six years. During this time, industry will be making technical and financial commitments to respond to the changing requirements and incentives of the hazardous waste management system. Once made, these commitments will be difficult to change. It is therefore both practical and highly desirable to conduct outreach programs to support and enhance the use of waste minimization as part of an overall waste management strategy and to reduce threats to human health and the environment. It should be noted that, in the event that mandatory controls are needed in the near term to control volume or toxicity of wastes generated by particular industries, EPA would use the authority that currently exists under Section 6 of the Toxic Substances Control Act.

Elements of this initial waste minimization program will include:

- Development and publication of an Agency policy statement on waste minimization including non-binding guidance to generators defining what constitutes waste minimization under the reporting and certification requirements of HSWA. To the extent possible, this guidance will be specific to particular industrial sectors and processes.

- Expansion of EPA's role in providing for technical and information assistance to generators, including small generators. Because the States have more direct contact with the generators and hence have more awareness of generators' needs and problems, EPA's primary role should be to support and encourage the States in the development of their programs. An appropriate EPA-sponsored technical assistance effort includes the following elements:

    - Assistance for States to initiate and develop programs for providing direct assistance to generators, especially small and medium sized generators.

    - Technical support of research and development and economic feasibility studies that might serve an entire region or have regional application.

    - Development of a computerized information system on waste minimization, accessible by the States.

- Encouraging voluntary waste minimization concepts within the review of new chemicals mandated under TSCA Section 5. EPA anticipates the preparation of a New Chemicals Information Bulletin advising submitters that waste minimization will be considered during the review of the relative risks of the new chemical substances and their existing substitutes.

The Agency should also establish a formal process of coordination with the States to ensure a continuing and responsive technical assistance and outreach effort over the longer term.

In addition, EPA will continue to examine specific elements of the "core" waste minimization program and make recommendations for legislative changes to the existing waste minimization requirements, if needed, as part of the next RCRA reauthorization. Among the possible options to consider would be modifications to the existing certification for generators and TSDFs, including:

- Prohibiting, where appropriate, certification of certain types of waste management practices as waste minimization.
- Providing, where appropriate, formal guidance as to what may be certified as waste minimization. Such guidance could apply generally or to specific industrial sectors. (Flexibility for appeals and exceptions must also be provided.)
- Requiring generators who have not undertaken any of the approved waste minimization activities, but who certify that there is no economically practicable alternative to their present waste reduction and management practices, to provide a written explanation of such certification.

Longer Term Options

Only after the land disposal restrictions and other principal provisions of the HSWA go into effect, and after EPA has developed the needed additional data on hazardous waste generation and management, will it be possible to determine whether standards of performance (including phasedown permits) or required management practices (such as waste audits) are necessary to achieve additional reductions in the volume or toxicity of wastes. The Agency therefore recommends that consideration of new mandatory programs be deferred until after such data can be gathered and analyzed, and proposes to report back to Congress on the desirability and feasibility of prescriptive approaches two years after the first of the land disposal restrictions has been fully implemented. Excluding the possibility of case–by–case extensions, the first of the land disposal restrictions will be fully implemented in November of 1988; EPA will, therefore, make its next formal report on this subject in December of 1990.

Conclusion

EPA still has much to learn about waste minimization and recognizes that the cooperation of private and public waste generators will be invaluable as it moves toward the development of sound long term policy. It also believes, however, that the incentives and trends within the hazardous waste management system are unmistakable, and that the program presented here comprises the most positive and constructive steps that can be taken at this time. Aggressive action in favor of waste minimization is clearly needed, but a

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major new regulatory program—at least for the present—does not seem desirable or feasible.

Incentives for waste minimization are already strong, so EPA must capitalize on them. Most lacking is access by generators to the information that will demonstrate the economic benefits of waste minimization to industry, overcome logistical problems, and help develop creative new approaches. This can be provided by a strong technical assistance and information transfer effort, which can achieve through voluntary means what would be inefficient and possibly counterproductive to attempt through regulation. Unfortunately, non-regulatory programs have often failed at EPA for lack of statutory or regulatory deadlines and institutional advocacy. For such a program to work, it must be given strong organizational support within the Agency.

EPA is willing to make this commitment, and seeks support from Congress to ensure its success.

FACT SHEET

Waste Minimization Findings and Activities

U.S. Environmental Protection Agency

October 1986

FY 85-86: Activities

Developed waste minimization technical support document (TSD) entitled *Waste Minimization - Issues and Options*, which includes:

- Definition of terms
- National profiles of recycling and source reduction practices

Source Reduction Profile in TSD

- The following 22 production and manufacturing processes were studied for the source reduction component of the TSD:

Production processes included:

— Acrylonitrile
— Electroplating
— Inorganic pigments
— Organic dyes
— Petroleum refining
— Printed circuit boards
— Synthetic rubber
— 1,1,1-trichloroethane
— Vinyl chloride
— Agricultural chemicals
— Epichlorohydrin
— Metal surface treatment
— Paint manufacture
— Phenolic resins
— Printing operations
— Synthetic fibers
— Perchloroethylene
— Wood preserving

Manufacturing processes included:

— Good housekeeping
— Paint application
— Metal parts cleaning
— Process equipment cleaning

- These processes were selected from among 200 different industrial processes. Criteria for selection included:
  - — Large volumes of hazardous waste generated
  - — Toxic hazardous waste generated
  - — Waste generated is part of California list of hazardous waste
- In the past, industry typically considered the implementation of source reduction practices only if such practices resulted in improved product yield or lower manufacturing costs.
- Since about 1970, however, environmental regulations under RCRA, the Clean Air Act, and the Clean Water Act have also, to some extent, influenced the use of source reduction techniques. In some cases, source reduction has occurred as a direct consequence of regulation, such as under the Clean Water Act requirements regarding wastewater treatment.
- Based on the qualitative analysis of the 22 production and manufacturing industries, extrapolated to all hazardous waste generators, it appears that the level of waste generation in terms of unit of waste per unit of product has declined over the last 15 years. Preliminary estimates suggest that industry might be generating about twice the amount of waste per unit of production than it does at present if no source reduction techniques were in place today.
- The potential for future reduction of waste appears to be significant. Preliminary evidence suggests that, within the next 25 years, aggregate waste generation volumes can be reduced an additional 15 to 30 percent by the extension of existing source control techniques.
- Through further extension of good housekeeping practices, waste minimization appears most promising in the industries characterized by high labor utilization, or where batch processing is used. Good housekeeping will have only limited effect in large-scale continuous processes with a relatively high degree of automation.
- For continuous processes generating large volumes of waste, the most promising SR technique is technology modification. Input material alteration is most effective in those processes where impurities constitute a high fraction of input materials.
- In a chemical process, catalyst use and reactor design appear to have the strongest potential impact on waste generation. Improved catalyst selectivity, along with optimum reactor design directly affects the amount of waste produced.

Recycling Profile in TSD

- Of the 42,000 M gal. of hazardous waste generated by U.S. industries in 1981, 1,575 M gal. (4 percent) were recycled.

Waste Group	Percent Recycled by Volumes
Solvents (halogenated and nonhalogenated)	24.0
Metal-bearing	28.0
Corrosives	29.0
Cyanides and other reactives	20.0
Halogenated organics (nonsolvent)	< 0.1

- Three manufacturing industries, the *Transportation Equipment* industry (SIC 37), the *Chemicals and Allied Products* industry (SIC 28), and the *Primary Metals* industry (SIC 33) accounted for 89 percent of the total volume of hazardous waste recycled in 1981. In contrast, generators in the *Motor Freight Transportation* (trucking) *and Warehousing* industry (SIC 42) did not report any recycling.

- Of the waste recycled, 81 percent by volume was recycled on-site.

- The breakdown of volumes of hazardous waste recycled according to onsite and offsite recycling suggests that the volume of waste recycled onsite increases as the total volume of waste recycled increases (i.e., facilities that recycle larger volumes of waste are more likely to recycle onsite).

- Offsite recycling accounted for the disposition of approximately 65 percent of the hazardous waste generated by SQGs in 1984. (Another 6 percent was recycled onsite.)

- Hazardous waste recycled in the greatest volume are dilute waste streams whose constituents can be reused in large-scale operations. This is true for the three highest volume waste streams recycled in 1981.

  - Spent acids and alkaline solutions (D002) recycled in large volumes by the *Chemical and Allied Products* industry and the *Machinery-Except Electrical* industry.

  - Wastewater treatment sludges from electroplating (F006) and chromium plating solutions (D007) recycled by the *Transportation Equipment* industry.

  - Pickle liquor (K062) a corrosive, metal-bearing waste, recycled mainly by the *Primary Metals* industry.

— These four waste streams account for 49 percent of total volume of waste recycled in 1981.

- Suitability for recycling is dependent upon market demand for and purity of the material.

- Data indicate that the higher the weighted average concentration of known constituents in a waste stream the more probable the use of recycling as a waste management option.

Other FY 85-86 Activities

Regulatory

- Implementation of HSWA waste minimization requirements on manifest, condition for onsite permits, and biennial reports.

- Providing informal guidance to generators on waste minimization

  — Solvent recycling
  — Offsite recycling (in general)
  — Participation in a waste exchange

Technical and Financial Assistance

- $4.75 million were available in supplemental grant funding to EPA Regional Offices; waste minimization activities were eligible for funding. Several waste exchanges have received funding.

- EPA's Office of Research and Development (ORD) Small Business/SQG Research Program has partially funded waste minimization programs in Minnesota and North Carolina.

- ORD also administered funding to Tufts University for study on foreign practices in waste minimization (Japan, Canada, Western Europe).

- ORD's Hazardous Waste Environmental Research Laboratory (HWERL) conducted research on waste minimization techniques in printed circuit board industry.

- HWERL is also developing a waste audit procedure and conducting audits at eight hazardous waste facilities. Facilities were chosen based on previously identified waste groups, e.g., solvents, corrosives.

Information Sharing and Management

- EPA co-sponsored the 1985 conference, *Waste Reduction - The Untold Story* , in Woods Hole, Massachusetts.
- EPA co-sponsored the 1986 conference, *Waste Reduction - The Continuing Saga* , in Woods Hole, Massachusetts.
- EPA co-sponsored in June 1986, *The Third National Roundtable of State Waste Reduction Programs.*
- In November, EPA will be hosting another meeting of the *State Waste Reduction Programs.*
- EPA staff have made waste minimization presentations at more than 15 national conferences.

FY 87 Activities

- Development of non-binding guidance on what practices constitute waste minimization.
- Development of new waste minimization biennial report data sheet for more consistent and accurate data collection.
- Development of technical transfer documents from information/data collected in the waste minimization TSD.
- Development of a computerized waste minimization information/data bank accessible by States and industry.
- Continued R&D on waste audits and development of technical transfer documents.
- Incorporation of Waste Minimization in TSCA Premanufacturing Notices.